smoke" is what prevents damage from frost, are not altogether correct in their statements. The pots for open coal fires are effective only in part and over quite limited areas. For low temperatures the proper method is to use a cover, and supplement this, if necessary, by small stoves and shallow pans of hot water.

THE FIREBALL OF SEPTEMBER 20, 1909.

By Prof. FRANK W. VERY. Dated Westwood, Mass., September 21, 1909.

At about twelve minutes before 8 p. m., ± three minutes, my wife saw a fireball low in the NNW. When first noticed it was near β Ursæ Majoris, and descended in a vertical direction to the horizon in about two seconds. There was a bright nucleus, apparently several minutes in sensible diameter, which was surrounded by a pale green coma of circular shape and about as large as the full moon when seen near the horizon. The appearance was that of a white light seen through a green gauze. The brightness of the entire object was perhaps half that of the crescent moon then visible low in the western sky, but instead of the yellow tint which the moon would have had if near the horizon, the fireball exhibited a decided green color, although it would be called a pale green, i. e., a mixture of green and white. The motion was a halting one, an alternate slowing and quickening, repeated twice or thrice. This may have represented a real revolution in a vertical plane about a more massive, but less luminous companion bolide.

If we assume that the meteor, when first seen, had an altitude above the horizon of 11.5° (sin=0.2) and a height above the earth's surface of 60 miles, its distance was roughly about 5 × 60=300 miles, and the real diameter of the coma would have been about 3 miles. The greenish color may have been due to the prominence of the green carbon band in its spectrum, and if so, the coma may have been a flame of carbon or hydrocarbon particles continuously produced from the nucleus and as rapidly consumed. If the bolide were moving 15 miles per second it would pass through the diameter of the coma in 1/5 second, and this time interval must represent approximately the duration of the flame, since there was no appreciable elongation of the coma. This gives for the velocity with which the particles (of carbon?) were expelled from the nucleus 1.5/0.2=7.5 miles per second, or one-half the assumed speed of the bolide, which is not an improbable figure. Bearing in mind the extreme rarification of the oxygen atmosphere at a height of 60 miles, carbonaceous particles, even in an extremely fine state of division, may plausibly be assumed to travel through a distance of $1\frac{1}{2}$ miles, the radius of the coma, before being entirely consumed.

The light was such as may have come from white hot incandescent particles of carbon or other solid material, mixed with a green gaseous flame. The intensity of light from the full moon being about 1/6 candle-meter or 1/50 candle-foot, that of the crescent moon may have been 1/500 candle-foot, and that of the fireball 1/1000 candle-foot. At a distance of 300 miles=1,584,000 feet this gives a total original brightness equal to that of a million powerful arc lights of 2,500 candles each. This distributed over a section of 21 million square feet gives 119 candle power per square foot. But since the actual composition of the coma was probably not that of a continuous flame, but rather that of a swarm of minute flaming particles separated by wide spaces, the intrinsic brightness of the flame can not be found.

TORNADOES IN KANSAS.

On the afternoon of June 24 there was a series of about seven tornadoes within a radius of 20 miles in Norton County in the northwest part of the State, and great damage was done to live stock and buildings, but, fortunately, no person was killed though there were a number of very narrow escapes. The one farthest north formed near Devizes and moved northeastward through Hendley, Nebr. Four or five other tornadoes formed from 4 to 10 miles northwest of Norton, each moving toward the northeast. In their paths houses, outbuildings, fences and windmills were destroyed and in some instances entirely blown away. About 83 head of live stock were either killed or badly injured. These disturbances were accompanied by heavy hail over narrow bands of country and a violent thunderstorm. The cloud of the last of this group of tornadoes resembled the letter "S" lying on its back thus ∽. The seventh tornado formed about 6 miles north of Lenora. It was a vertical column and moved slowly, traveling only about 4 miles in forty-five minutes, and people had time to get out of its way. The paths of the tornadoes were from 120 to 400 feet wide. The value of the property destroyed is estimated at $22,500. Further details are given in the Monthly Climatological Report, Kansas Section, for June, 1909.—*T. B. Jennings.*

TORNADOES IN MISSOURI.

(Extract from Monthly Climatological Report, Missouri Section, June, 1909.)

The weather map of June 22, 1909, showed a barometric depression over most of the territory lying between the Mississippi and the Rocky Mountains, and extending from Sonora, Mexico, to Manitoba, Canada, with rather well-developed lows at both extremes. On either side of the depression were fairly well-formed highs, one resting over the South Atlantic States and the other over the north Pacific slope. On the east side of the low area the temperature gradient was decidedly flat, the isotherm of 70° passing through the middle and following the general trend of the depression; on the west side there was a temperature gradient of about 30 degrees in 500 miles.

While this distribution of pressure would indicate thunderstorms, or more accurately thundershowers, one would hardly expect tornadoes. Yet, several severe local storms having tornado characteristics occurred in Missouri on the date mentioned. The most noteworthy of these occurred near Monett, Barry County, in the southwestern part of the State. The tornado, which, from reliable reports, had a well-defined pendant funnel-shaped cloud, was first seen between 8 and 9 p. m., central time, about 3 miles southwest of Monett, whence it moved eastward leaving the ground when about 3 miles southeast of that village; thence it travelled northeastward, again touching the ground about 12 miles northeast of Monett near Aurora, Lawrence County, where, however, it did no damage, and then disappeared.

The section of country over which the storm passed is comparatively thinly settled. The storm's path averaged about 350 feet. From the evidence furnished by fallen trees and other wreckage, there must have been a decided rotary motion to the storm. The estimated damage and loss to property and live stock was about $8,000, of which at least $1,000 is covered by tornado insurance. Only one person was killed, so far as could be ascertained, and seven injured. Some fish were found a quarter of a mile from a pond which lay on the path of the tornado.—*George Reeder.*

WEATHER CYCLES IN THE GROWTH OF BIG TREES.

By Prof. A. E. DOUGLASS, D. Sc. Dated Tucson, Ariz., October, 1908.

NOTE BY THE EDITOR.—Inasmuch as it was impossible to reproduce in the Monthly Weather Review the diagrams furnished by Professor Douglass, the Editor asked him kindly to furnish the table of original measurements so that students of this interesting subject may have at hand the valuable material for further investigations, which indeed now gives this memoir a specially high value.—*C. A.*

Climatically Arizona is divided into two parts, the northern, a great plateau at an average elevation of 6,000 feet, and the southern, a broken country consisting of scattered mountain ranges separated by broad level valleys averaging some 2,000 thousand feet above the sea. The higher elevations, culminating in the San Francisco Peaks near Flagstaff, are covered with great forests of yellow pine (*Pinus ponderosa*), a fine timber tree with heavy cylindrical trunk and a rather bushy top. The trees are scattered gracefully over the plains and hills and, with the remarkable absence of undergrowth, render travel through their shady midst attractive and delightful.

Contrary to Arizona's reputation, northern Arizona has really a cold climate. Several feet of snow lie on the ground during winter, and the summer evenings are rarely warm enough for one to sit outdoors. For centuries these magnificent pines have stood there enduring all the vicissitudes of heat and cold, flood and drought. They should contain some record of such alternations. Other studies of weather variations have been made upon records extending back from twenty to fifty years. These trees, if they prove to convey such information at all, will yield data covering two to five centuries.

The working hypothesis which in 1901 and before gave a beginning to the collection of material along these lines was as follows: (1) the rings of a tree measure its food supply; (2) food supply depends largely upon the amount of moisture, especially where the quantity of moisture is limited and the life struggle of the tree is against drought rather than against competing vegetation; (3) in such countries, therefore, the rings are likely to form a measure of the precipitation. In planning the work three fundamental steps were anticipated. First, to prepare a curve of tree growth; second, to find if there exists in this any connection with precipitation; third, by carrying this back through long periods to find whether meteorological variations, if discovered, show association with astronomical phenomena.

REASONS FOR PURSUING THE INVESTIGATION.

That tree growth does give a fairly accurate record of precipitation in its own vicinity is evident from an examination of the accompanying figure (fig. 3). In it the curve of annual growth represents the average of 25 trees for the eight years during which the United States Weather Bureau station has been located at Flagstaff, Ariz. The trees were scattered over an area of 12 to 15 miles in extent near that town. The curve of rainfall gives the annual precipitation for years beginning November 1. This division of the year is taken because precipitation in November and December is almost invariably in the form of snow, and its benefit to the trees goes over into the following year. Evidently this arboreal new year depends on temperature.

It is at once apparent that the annual tree growth becomes a very close measure of the annual precipitation.[1] A similar agreement over longer periods of time is shown in fig. 4, where a comparison is made between the tree growth derived from the first six trees, and the average precipitation over longer periods at more distant stations. The rainfall curve is a "nine-year smoothed" curve from Prescott, Ariz., distant 67 miles southwest. By "nine-year smoothed" is meant, not the precipitation for each year in its place, but the average of a nine-year group. As in these longer periods we are studying the general condition of the country rather than the individual year, and as good or bad conditions of the country require much time, perhaps years, to be overcome, the average of each of these groups of nine is placed at the end of the group instead of at its center. A strong connection between the precipitation at Prescott and the annual tree growth nearly 70 miles distant is evident. A general consideration of this topic leads me to the opinion that the agreement between tree growth and rainfall is fairly close in the neighborhood of the trees, but that for more distant localities, such as Prescott, Ariz., (67 miles southwest), and the California coast (500 miles west) the agreement in individual years is not to be expected, although averages of three or more years show strong similarity.

[1] Prof. E. E. Bogue, of Lansing, Mich., in the Monthly Weather Review of June, 1905, finds this connection.

ONE RING TO A YEAR.

In comparing rings and the rainfall over long periods of years, a preliminary condition is that the time of formation of any individual ring shall be subject to identification. As a rule the individual rings of the trees are extremely well marked and leave no doubt whatever as to their purely annual or seasonal character. However, doubtful cases occasionally appear, with greater frequency near the center of the tree. For the last two hundred years, I estimate that 2 per cent is the average number of doubtful cases. The arguments bearing upon this subject are as follows: (1) the agreement shown in fig. 3 between tree growth and rainfall in individual years shows the yearly character of the rings; (2) at the 7,000 feet of elevation at which these trees grew, the seasons are very sharply defined; the mean temperature for January is 29° F., and for July is 65° F.; frost, therefore, gives a sharply seasonal character to the growth; (3) the examination of stumps and logs at different seasons during several years showed entire consistency in the formation of a narrow red ring in autumn and winter and a broad, soft white ring in summer; (4) in the investigation of uncertain cases, it is a great help to trace the doubtful ring around different portions of the tree. In some other part, the ring's claim to individuality is often clearly settled.

In deriving the tree growth since the year 1700 it may be assumed that as many errors have been made in one direction as in the other, and they therefore neutralize each other. Their effect is simply to lessen the intensity of the variations in the tree. As to location of errors, I doubt if there are any appreciable ones subsequent to 1760. Practically all the estimated 2 per cent of cases come between 1700 and 1760. On account of the comparative frequency of doubtful cases in the early rgs inof a tree, these rings were not made use of in forming the means.

COLLECTION AND MEASUREMENT OF SECTIONS.

In January, 1904, I visited the log yards of The Arizona Lumber and Timber Co., Flagstaff, and spent several hours in the snow, measuring the rings of section No. 1. For all subsequent numbers Mr. T. A. Riordan, President of the Company, most kindly came to my assistance by having thin sections cut from the ends of logs or stumps and sent to me in town, there to be measured more conveniently. Sections VII to XXV were cut at my direction on the spot where the tree grew, and where I was able to mark the points of the compass on the sections and otherwise identify and describe their location. These 19 sections were freighted to Tucson, where the work work on them has been done.

The measures consist in determining the radial thickness of each annual ring in millimeters. For this purpose a steel meter rule was placed radially on the section, and by the aid of a magnifying glass, the position of every ring was read off on this scale. Mr. Willard P. Steele rendered most valuable assistance as recorder. The average age of the trees was three hundred and twenty-four years. With the extra measures taken for one purpose and another the total number of original measures was nearly ten thousand, and subsequent calculations have tripled that number. The rings proved remarkably susceptible to measurement. That which I call the winter or autumn ring is a thin, hard, pitchy ring, somewhat indefinite on the autumn side but sharply bounded on the spring side. That sharp side was therefore the point measured. The substantial growth of the tree consists of a wide, white, pulpy summer ring. Under the microscope the winter cells look lean and emaciated, while the summer cells are round and well fed.

REDUCTION.

Lists were then made of the sizes of individual rings of every tree, and these again were combined into three groups, consisting of *A*, six trees from about 3 miles south of Flagstaff; *B*, nine trees from about 12 miles southwest of Flagstaff;

and *C*, ten trees a mile east of the last group. I take this opportunity of thanking several persons who assisted me in these reductions.

These groups, as above described, were studied in order to differentiate between accidental variations in the individual tree and general variations due to some prevalent external cause. Any given characteristic found in these three groups separately could certainly be relied on as due to some cause outside the trees. A comparison clearly reveals the entirely general character of the longer periodicities hereinafter discussed, and shows also many lesser variations common to the three groups.

One interesting group characteristic is brought out by a knowledge of the location at which the trees grew. It will be noticed that the group *A* of six dropped to its strong minima in 1780 and 1880 more promptly than the others, *B* and *C*. This appears to be connected with the soil upon which the trees grew. Group *A* stood on a limestone formation where the soil is porous and the rocks below full of cracks. The other groups grew on recent lavas, very compact and unbroken, covered with a rather thin layer of clayey soil. With the former, *A*, therefore, the rain passed quickly through the soil and away, and we do not see so much of the conservation of moisture as in the other groups where the water could find no convenient outlet.

ANALYSIS OF THE CURVE.

The average of the three groups, *A*, *B*, *C*, gives us the final curve of tree growth. The large pronounced minima here shown had been previously found in the separate groups. The strong minima in the years 1880, 1845, etc., gave an average period of about thirty-three years. But it was also evident that a shorter period of about twenty years was producing a well-marked effect. The combination of these two periods altered the time of observed maxima and minima to such an extent as to hide the true values of the periods. The two curves were separated in the following manner. A thirty-three-year smoothed mean was made. This being the period of the longer variation, the longer variation itself disappears; but as this is one and one-half times the shorter variation the latter remains in the curve as a smothered reversed curve. The regular fluctuations in a period of 21.2 years are evident enough on close scrutiny.

Having the 21.2 variation isolated, it was easy to separate the other, which proved to be closely 32.8 years. Harmonic curves representing these two periods are shown in the lower part of the figure. Their combination is shown in the uppermost curve, drawn close to the curve of tree growth for ready comparison. The accordance in all pronounced variations is most striking. If one were given this combined harmonic curve and told to compare it with the annual growth of 25 trees in the great forest of northern Arizona, it would be quite beyond the possibility of mere accident that he should find the exact agreement exhibited.

As a check on the preceding result the older trees were selected and an average of seven taken over a period of three hundred and fifty years. In addition to that, the oldest two were averaged for a period of four hundred and seventy-five years. At the top of fig. 9 is placed the harmonic curve derived as described in the last paragraph. These check curves support the results obtained.

BOTANICAL CURVES.

One point of great botanical interest has already been mentioned, namely, the immediate correspondence between yearly rainfall and tree growth. Another important point has been touched upon, namely, the speed of growth in relation to the soil beneath. On the whole, the growth seems to be more rapidly influenced by changes of moisture upon limestone than upon volcanic rocks. I am not sure that there is much real difference in average speed. Another point appeared in fig. 8, in the line of tree growth uninfluenced by external factors. That rate of tree growth is represented in fig. 10 where the relation between growth and radius is illustrated in the upper part of the figure. If the trees were simply increasing in diameter without growing upward, the size of the rings would be inversely proportional to the radius of the tree section, other things being equal. If the food of the tree were distributed in upward growth as well as in circumferential increase, the size of the rings would be inversely proportional to the square of the radius. It will be seen that the actual curve of growth is between these two.

The lower section of this same figure gives the point of the compass toward which the maximum trunk growth occurs. It is a little east of north. This result comes from the 19 trees of groups *B* and *C*. The average variation between the maximum growth in the northerly direction and minimum growth to the south is 12 per cent. The explanation of the increased growth to the north is in the increased amount of moisture on that side, due to the slower melting of snow and the decreased evaporation in the shade. For nearly all these trees, also, the ground had a gentle slope toward the south, so that moisture working down hill would come to the north side first. All of these facts agree in pointing to moisture as the factor of greatest influence in tree growth. It appears probable that the red winter rings in the trees are governed directly by lowness of temperature, and the white rings by abundance of moisture.

SUGGESTIONS OF SHORTER PERIODS.

There are portions of the curve of tree growth which suggest a six-year variation, e. g., 1840 to 1870, also 1740 to 1760, represented in fig. 11 and others. In attempting to find connection, if any, between the longer growth variations and meteorological elements on the California coast, the precipitation in the latter region was reduced to a nine-year smoothed curve as shown in the figure. On plotting this curve, a six-year variation became at once evident. This shows remarkably in the exhibited curve of "'Frisco" rainfall. The minima appear almost equally well-marked in the San Diego curve, and a trace of them may be discerned in those of Yuma and Prescott. The rainfall curves of Santa Fe and El Paso seem to be reversals of the coast types.

This six-year variation is apparent in the rainfall of San Francisco for the last half century as published on page 11 of "Climatology of California," by Alexander G. McAdie (Weather Bureau Bulletin L). In this diagram, the minima show a fair distribution on a six-year interval.

Both in the San Francisco rainfall curve mentioned and in the curves of the last figure these six-year periods appear to go in pairs, forming a full period of between eleven and twelve years. In the temperature curves in fig. 12, the approximately eleven-year character of the curve is more apparent. For example, the Sacramento annual mean temperature has maxima in 1854, 1864, 1875, 1885, 1896. The San Diego temperature curve has minima in 1859, 1870 (or later), 1880, 1894. The average value of this periodic change in many curves is 11.3 years, and it is upon this period that the investigation is continued.

ELEVEN-YEAR PERIOD.

Variations of weather elements in the eleven-year period are not new (see Prof. F. H. Bigelow's "Studies of the Diurnal Periods in the Lower Strata of the Atmosphere," MONTHLY WEATHER REVIEW, July, 1905).

At the top of the figure is found the annual mean precipitation for the last fifty years, at San Francisco (the dotted line) and San Diego (the broken line), and their average (the continuous line), plotted in a period of 11.3 years. This curve shows two well-marked maxima dividing the whole interval into two similar halves.

So far as this curve is concerned, the variation is on a 5 2/3-

year period. But this curve is so closely related to the curve of temperature below it that it is still best to regard it as having the double length.

The temperature curve is derived from the San Diego records since 1851, and shows the unmistakable eleven-year period, since it can not be divided into two equal parts. Below that is given the inverted sun-spot curve for the years 1864 to 1874, plotted from Young's General Astronomy. Lastly is given the 11.3-year period of tree growth, including the final averages of 25 tree sections for the years 1701 to 1906, inclusive. In order to effect a comparison between these curves, they are all calculated as beginning at the same epoch—namely, the year 1863.0—and in the figure the period is divided into ten equal parts. Each part therefore represents a little over one year.

Now, to express the causal relation between these phenomena, one should consider first the inverted sun-spot curve. The sun-spot minimum occurs at a point between .3 and .4 along the interval, and the maximum occurs between .7 and .8. The sun-spot minimum is accompanied by, and presumably causes, the temperature maximum, the sun having fewer "cooling spots" on it. The difference thus produced between maximum and minimum temperatures is nearly 2° F. The temperature maximum, at .3, is quickly followed by, and presumably causes, the maximum in precipitation. The rise to the average from the minimum temperature accompanies the second maximum in precipitation. The proportionate total variation of rainfall is over 40 per cent of this mean. It is a longer jump[2] than one likes to go from coast rainfall to northern Arizona tree growth; but that is the best we can do and use long series of weather observations. The tree-growth curve has the same form as the rainfall curve, except that it drops more quickly from maximum to minimum. Its variations are in the neighborhood of 3 per cent.

MEANING OF THE LONGER PERIODS.

The tracing of the short variations in tree growth to solar influence suggests a cause for longer periods. In fig. 14, at the top, is a smoothed curve of San Diego temperature, and below it a smoothed curve of Prescott precipitation. The connection between these is of the same sort and just as striking as that between the coast temperature and rainfall. Below the Prescott curve is the smoothed curve of tree growth showing, as is entirely reasonable, a delay of a few years in reaching its minima and maxima; for the general effect of good and bad years on the trees may last for some time. This lagging is well seen in a direct comparison between the coast temperature and the tree growth, and amounts to perhaps six or seven years. The amount of the tree growth variations is immense, fully reaching 25 per cent above and below the average. These longer variations therefore indicate far more profound and immense fluctuations in their cause than the lesser inequalities.

But as the causal relation from solar activity to tree growth is found in the lesser inequalities, it seems fairly evident[2] that the cause of the longer variations is to be found in solar changes of great magnitude in periods of approximately 21.2 and 32.8 years. The intensity of these variations, judging by their effects, may be even as much as eight times greater than the solar changes involved in sun-spot phenomena.

SUMMARY.

The following is a summary of the periods here observed.

In tree growth:

I.	32.8 years.	Minimum in 1880.6.
		Variation about 25 per cent from mean.
II.	21.2 years.	Minimum in 1884.3.
		Variation about 7 per cent from mean.
III.	11.3 years.	Minimum in 1863.5.
		Variation about 3 per cent from mean, but extremely variable.

In weather elements:

IV.	11.3 years.	Variation in coast rainfall.
		Minimum in 1865.2.
		Variation 20 per cent from mean.
V.	11.3 years.	Variation in coast temperature.
		Minimum in 1864.5.
		Total variation 1.80° F.

Since the variation in tree growth in the eleven-year period averages only 3 per cent and in the longer period averages as high as 25 per cent, it is evident that we are in the latter considering factors of most profound influence upon biological conditions upon the earth. Such factors could easily affect crops and all products of a vegatational character, and full knowledge regarding them is of the utmost importance. If my reasoning has been correct, therefore, we have now made a beginning of definite knowledge of these factors by aid of the great pine trees of northern Arizona, and have established a method of study worthy of extension to other great forests of the world.

NOTES FOR TABLE I.

Table 1 presents the original scale readings from which can be derived the yearly growth for each of the 25 trees discussed in the accompanying text. The first column gives the year near whose close the outer edge of each dark pitchy "annual ring" is supposed to have been formed.

The following significant letters or marks are used throughout the original manuscript table and will give the reader an idea of the care with which the observations were made; but it has not been practicable to print all the items in detail in our present table.

[ ], square curves inclose the scale reading on the edge of a ring or on a secondary ring. The small percentage of uncertainty in secondary rings has been referred to in the text.

{, the brace joins two rings that I judge to be separate, but about which there is a question.

—, a dash between a reading and a bracketed reading indicates that the ring is continuous between the two; the bracketed gives the inner edge.

"At," the letters "At" mean that the secondary ring is attached to the

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[2] Most climatologists will agree that the great distance and complete topographic change covered by this "jump" are sufficient to make abortive any attempt to correlate Pacific coast precipitation with tree growth in northern Arizona.

Concerning the supposed influence of sun spots on terrestrial temperatures, rainfall, tree growth, etc., the reader is reminded that this whole question of sun spots and terrestrial meteorology still remains in the realm of speculation and has not advanced beyond. It is to be noted that in the present work Professor Douglass finds that sun-spot minima are epochs of rainfall maxima and temperature maxima. In the work by Bigelow which he quotes (Monthly Weather Review, November, 1903, **31**: 515, fig. 13), Bigelow finds that the temperature curves vary directly with the sun-spot curves on the Pacific coast, are indifferent to them in northern Arizona, and vary inversely with them in the west Gulf States.

On the other hand, while Bigelow and Douglass seem to disagree about the relation between sun spots and temperature, Newcomb, Koeppen, and others have found that the synchronism between sun spots and temperature fluctuations is very hard to perceive and that the temperature residuals are insignificant. In a recent monumental work (Trans. Amer. Phil. Soc., 1908, **31**: 309–387) Newcomb has demonstrated: (1) That the eleven-year period in temperature has an amplitude of but 0.26° C. or 0.47° F.; (2) That the epochs of maximum temperature precede the sun-spot minima by 0.33 year, while the minimum temperatures follow the sun-spot maxima by 0.65 year. Newcomb comes to the general conclusion that "*all the ordinary phenomena of temperature, rainfall, and winds are due to purely terrestrial causes, and that no changes occur in the sun's radiation which have any influence upon them*" (p. 384). C. G. Abbot (Ann. Astrophys. Obs., Sm. Inst., 1908, **2**: 177–201) finds that "the intensity of solar emission varies considerably" and that the average temperature of a large number of inland stations is above the normal at the time of the sun-spot minimum "so that the solar radiation is more intense at the sun-spot minimum," but he also finds that the temperatures are about normal at the sun-spot maxima, and that the temperatures show but 0.6° C. extreme fluctuation on either side the normal.

The question of a causal connection between sun-spot frequency and the growth of the great Arizona pines is evidently not yet settled. Our readers will find it more useful and profitable to study actual weather conditions and ground-water conditions in connection with the growth of plants, rather than to search for such remote influences as those possibly exerted by sun spots.—*C. A., jr.*

primary, the dark material fading somewhat between the two. The two together obviously form the winter tissue.

D, signifies a double ring and is used in cases where the second ring is not measured. This usually applies to cases where the interval is too small. Invariably the ring is traced for some distance to discover whether it is one double or two separate rings.

B, b, indicates that the ring is broad compared with adjacent rings in that part of the section. The small letter is generally used near the outside of the tree where the rings are narrow, and the capital letter near the center where the rings are all large. Rings thus marked have a well-defined age.

W, w, indicates a *wide* ring, distinguished from *broad* by having no well-defined inner edge. On the average broad and wide mean a winter ring having at least one-eighth of the total yearly growth.

f, indicates a faint ring, which character, like breadth and width, is estimated by comparison with the adjacent region.

The condition of the section is given as a whole. The line measured was always selected very carefully with reference to freedom from foreign irregularities in the rings, such as are caused by knots, and from cracks or breaks. Any unavoidable cracks are mentioned in the following remarks. [The Editor has been able to publish only those items that directly affect the accuracy of the measurements and averages that enter directly into the present discussion as to cycles of growth.–*C. A.*]

Notes on each individual section measured in Table 1.

Section I, yellow pine.—The scale, divided to millimeters, was read by estimation to tenths of a millimeter or hundredths of a centimeter. The scale readings increased from the outer bark inward. The reading of the first break in the bark was at 0.40 cm. The beginning of the red bark-ring is at 0.67 cm. The beginning of the last sap-ring is at 0.80 cm., hence this is taken as the beginning of the growth for the year 1903, and 0.13 cm., or 1.3 mm., as the total growth during 1903. The scale readings increase toward the center of the tree up to 5.57 cm. for 1874 when the scale was readjusted to read 0.02 cm. at this point. A similar readjustment took place at 1740, where 28.94 cm. A crack in the wood 0.25 cm. in width occurs at 1656 between the readings 19.92 and 20.17. The center of the section is at the reading 29.35 cm.

Section II, yellow pine.—A crack of 0.16 cm. occurs between 1650 (9.36 cm.) and 1651 (9.61 cm.) so that the annual growth for 1651 is 0.09 cm. and not 0.25 cm. A crack of 0.02 cm. between 1644 (8.75 cm.) and 1643 (8.60 cm.) so that the growth for 1644 is 0.13 cm. and not 0.15 cm. A crack of 0.15 cm. between 1599 (1.85 cm.) and 1598 (1.48 cm.) at the center so that the growth for 1599 is 0.22 cm. and not 0.37 cm.

Section III, yellow pine.—The divided scale was readjusted at 1685 so that the readings 0.03 cm. and 27.27 cm. relate to the same ring. The center is at 1610 (12.90 cm.).

Section IV, yellow pine.—A crack of 0.01 cm. between 1684 (14.67 cm.) and 1683 (14.60 cm.) so that the growth for 1684 is 0.06 and not 0.07 cm. A crack of 0.02 cm. between 1680 and 1681 so that the growth for 1681 is 0.06 and not 0.08 cm. A crack between 1639 and 1640 so that the growth for 1640 is 0.05 and not 0.11 cm. A crack of 0.06 cm. between 1579 and 1580 so that the growth for 1580 is 0.08 and not 0.14 cm. The center is at 0.38 cm. for the year 1528.

Section V, blackjack (Quercus nigra).—A crack of 0.01 cm. between 1777 and 1778 so that the growth for 1778 is 0.09 and not 0.10 cm. The center is 7.00 for the year 1632.

Section VI, blackjack (Quercus nigra).—The center is at 31.30 cm. for the year 1691.

Section VII, yellow pine.—Measured on the north side of the center. At 1875 (36.35 cm.) blue rot begins and at 1807 (25.80 cm.) blue rot ends. The center is at 1702 (1.40 cm.). The total growth on the radii from the center to the 1906 ring is as follows: on the

North side, 39.5 cm.
East side, 42.0 cm.
South side, 37.9 cm.
West side, 37.2 cm.
Greatest, east ½ north, 42.2 cm.

Section VIII, yellow pine.—Was measured on the west side of the center, west side of the tree. At 1587 (1.68 cm.) a defect in the wood. The center is at 1577 (0.40 cm.). The total growth from the center to the 1906 ring is as follows:

North side, 50.0 cm., defective.
East side, 50.0 cm.
South side, 46.0 cm.
West side, 55.5 cm.
Greatest, west, 55.5 cm.

Section IX, [yellow pine?].—Crack at 1538 (0.05 cm.) so that the growth for 1538 is 0.09 and not 0.14 cm. Center at 1520 (25.95 cm.). The total growth from the center to the 1906 ring on the

North side, 37.0 cm.
East side, 34.0 cm.
South side, 38.0 cm.
West side, 42.0 cm.
Greatest, west-southwest, 43.5 cm.

Section X, yellow pine.—Measured on the west-northwest side. The center is at 1584 (0.40 cm.). The growth from the center to the 1906 ring on the

North side, 43.0 cm.
East side, 41.0 cm.
South side, 40.0 cm.?
West side, 44.5 cm.
Greatest, west-southwest, 45.0 cm.

Section XI, yellow pine.—Measured due east of center. The center is at 1602 (0.70 cm.). The total growth on the

North side, 37.5 cm.
East side, 33.0 cm.
South side, 26.5 cm.
West side, 32.5 cm.
Greatest, northwest, 42.0 cm.

Section XII, yellow pine.—Measured on the northwest by north side. The center is at 1392 (1.10 cm.). The total growth on the

North side, 51.5 cm.
East side, 48.0 cm.
South side, 44.0 cm.
West side, 43.2 cm.

Section XIII, yellow pine.—Measured northeast by north from the center. The center is at 1412 (0.00 cm.). The total growth on the

North side, 49.3 cm.
East side, 42.0 cm.
South side, 38.0 cm.
West side, 41.3 cm.
Greatest, northeast, 50.0 cm.

Section XIV, yellow pine.—Measured west by south from the center. The center is at 1585 (38.10 cm.). The total growth on the

North side, 38.0 cm.
East side, 40.0 cm.
South side, broken.
West side, 35.0 cm.
Greatest, northeast, 42.0 cm.

Section XV, yellow pine.—Measured west ½ north. The center is at 1554 (60.50 cm.). The total growth on the

North side, 41.0 cm.
East side, 35.0 cm.
South side, 34.0 cm.
West side, 37.5 cm.
Greatest, east 5° south, 41.0 cm.

Section XVI, yellow pine.—Measured west by north. The center is at 1540 (1.10 cm.). The total growth on the

North side, 39.0 cm.
East side, 39.8 cm.
South side, 39.8 cm.
West side, 35.5 cm.
Greatest, east 5° south, 40.0 cm.

Section XVII, yellow pine.—Measured south. The center is at 1506 (26.10 cm.). The total growth is on the

North side, 42.0 cm.
East side, broken.
South side, 39.0 cm.
West side, 38.0 cm.
Greatest, north-northwest, 43.0 cm.

Section XVIII, yellow pine.—Measured north-northeast. The center is at 1692 (0.66 cm.). The total growth on the

North side, 42.6 cm.
East side, [46.5?] cm.
South side, 38.4 cm.
West side, 39.0 cm.
Greatest, north 5° west, 42.5 cm.?

Section XIX, yellow pine.—Measured northwest by north. The center is at 1666 (0.19 cm.). The total growth on the

North side, 37.7 cm.
East side, 31.0 defective.?
South side, 32.3 cm.
West side, 38.8 cm.
Greatest, northwest by north, 44.3 cm.

The readings for 1671–67 are uncertain, and in most of the sections the 6 or 7 lines nearest the center are uncertain [although no such ?? appear in the original manuscript tables].

Section XX, yellow pine.—Measured north. The center is at 1639 (1.70 cm.). The total growth on the

North side, 37.5 cm.
East side, 38.0 cm.?
South side, 34.5 cm.
West side, 34.5 cm.
Greatest, northeast, 43.5 cm.

Section XXI, yellow pine.—Measured north. The center is at 1643 (4.00 cm.). The total growth on the

North side, 40.3 cm.
East side, 44.0 cm.?
South side, 37.0 cm.
West side, 36.0 cm.
Greatest, northeast, 49.2 cm.

Section XXII, yellow pine.—Measured northwest. The center is at 1570 (0.10 cm.). The total growth on the

North side, 45.– cm. defective.
East side, 40.8 cm.
South side, 32.6 cm.
West side, 38.5 cm.
Greatest, north-northwest ½ west, 46.4 cm.

Section XXIII, yellow pine.—Measured north-northwest. From 1639 (16.00 cm.) to 1657 (16.95 cm.) the measurements were crossing a crack. The center is at 1521, (–0.05 cm.) and from 7.5 cm. to 11.0 cm. the circle of rings shows considerable irregularity. The total growth on the

North side, 41.0 cm.
East side, 42.0 cm.
South side, 44.0 cm.
West side, 47.7 cm.
Greatest, southwest by south, 48.2 cm.

Section XXIV, yellow pine.—Measured east 10° south, and readings were to 0.5 mm.; there was a crack of 0.2 cm. between 83.650 and 83.880 cm., so that the annual growth is 1.1 mm. and not 1.3 mm., but 1.3 mm. has been used in the computations. The center is at 65.050 cm. The total growth on the

North side, broken.
East side, 36.5 cm.
South side, 34.5 cm.
West side, 38.0 cm.
Greatest, west-southwest, 40.5 cm.

Section XXV, yellow pine.—Measured southwest. Center at 1574 (0.73 cm.). The total growth on the

North side, broken.
East side, broken.
South side, 31.0 cm.
West side, 32.0 cm.
Greatest, north (?), 40.0 cm. (?).

TABLE 1.—*Original scale readings, in centimeters, of Douglass's measurements of the Arizona pines.*

Year	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.	Year.
1906	.....	.....	.....	.....	.....	.....	39.10	55.69	67.15	39.75	33.50	43.77	45.88	74.01	97.00	37.00	65.00	40.78	44.23	39.10	44.18	44.43	43.10	98.615	32.75	1906
05	.....	.....	.....	.....	.....	.....	38.95	.54	.12	.70	.46	.72	.84	73.94	.77	.81	64.94	.70	.12	.08	.10	.37	.09	.595	.72	05
04	.....	.....	.....	.....	.....	.....	.86	.40	.08	.64	.44	.68	.80	.87	.73	.78	.90	.64	43.98	.05	.03	.31	.06	.555	.68	04
03	0.80	28.10	15.93	29.40	29.06	00.16	.80	.29	.06	.58	.40	.63	.75	.84	.70	.74	.83	.58	.88	.00	43.95	.26	42.97	.530	.64	03
02	0.93	.01	.83	.36	.00	.30	.67	.15	.03	.53	.37	.56	.72	.78	.66	.72	.75	.52	.69	38.97	.88	.20	.85	.505	.58	02
01	1.01	27.94	.74	.35	28.96	.36	.63	.05	.01	.50	.34	.51	.68	.75	.63	.69	.70	.49	.59	.93	.81	.15	.78	.475	.54	01
1900	.13	.84	.66	.32	.93	.47	.51	54.94	66.98	.46	.30	.45	.65	.71	.62	.64	.65	.40	.41	.89	.74	.10	.70	.440	.50	1900
99	.21	.79	.57	.30	.90	.55	.39	.83	.96	.41	.26	.42	.62	.64	.58	.59	.61	.34	.30	.84	.69	.05	.66	.380	.46	99
8	.34	.73	.50	.27	.83	.63	.31	.70	.93	.36	.23	.38	.56	.58	.56	.52	.55	.27	.21	.78	.62	43.99	.60	.320	.40	8
7	.53	.66	.39	.24	.79	.75	.15	.54	.88	.29	.20	.30	.52	.49	.53	.48	.51	.18	.06	.71	.54	.92	.57	.230	.36	7
6	.70	.58	.30	.21	.74	.87	.06	.41	.85	.21	.16	.25	.49	.41	.50	.41	.47	.06	42.95	.65	.48	.86	.54	.160	.31	6
5	.85	.52	.20	.19	.68	.97	37.91	.28	.81	.15	.14	.18	.45	.35	.48	.34	.43	39.94	.80	.60	.43	.79	.49	.095	.26	5
4	2.09	.44	.10	.15	.64	1.05	.85	.16	.76	.10	.12	.14	.42	.27	.45	.28	.40	.84	.70	.55	.35	.75	.46	.050	.22	4
3	.30	.36	.00	.11	.56	.14	.76	.05	.71	.04	.09	.07	.38	.21	.42	.23	.35	.73	.55	.49	.30	.72	.43	.000	.17	3
2	56	.26	14.90	.06	.50	.23	.63	53.96	.67	.00	.06	.03	.35	.14	.38	.17	.30	.65	.46	.45	.25	.67	.39	97.970	.13	2
1	.86	.18	.81	.00	.45	.29	.54	.88	.63	38.94	.03	42.98	.30	.07	.36	.12	.25	.59	.36	.42	.20	.64	.33	.940	.08	1
1890	3.10	.13	.74	28.96	.38	.36	.45	.77	.56	.88	32.98	.94	.25	.01	.33	.08	.20	.52	.26	.38	.16	.59	.28	.890	.03	1890
89	.32	.06	.64	.93	.34	.50	.37	.66	.52	.81	.96	.88	.20	72.94	.30	.03	.16	.41	.12	.31	.11	.54	.22	.840	31.99	89
8	.53	.02	.57	.89	.29	.59	.28	.54	.49	.76	.94	.84	.15	.87	.28	36.98	.12	.32	.02	.29	.05	.48	.11	.785	.96	8
7	.77	26.97	.50	.86	.25	.66	.22	.43	.46	.70	.92	.79	.11	.81	.26	.94	.09	.23	41.90	.23	.00	.43	.03	.740	.92	7
6	.98	.93	.44	.83	.21	.74	.16	.34	.43	.66	.90	.74	.07	.75	.24	.89	.05	.18	.83	.16	42.96	.40	41.93	.700	.87	6
5	4.16	.87	.40	.81	.17	.82	.09	.25	.39	.62	.84	.70	.03	.69	.22	.84	.01	.13	.75	.11	.93	.36	.83	.670	.83	5
4	.38	.82	.35	.77	.14	.94	.04	.14	.34	.57	.82	.65	44.98	.63	.20	.79	63.98	.06	.65	.06	.87	.32	.76	.640	.78	4
3	.50	.77	.28	.75	.10	2.00	36.99	.05	.30	.54	.80	.60	.94	.56	.18	.74	.95	38.98	.56	37.97	.82	.29	.69	.600	.75	3
2	.60	.75	.25	.74	.06	.09	.93	52.96	.26	.49	.75	.55	.90	.50	.16	.70	.93	.90	.50	.92	.77	.26	.59	.560	.70	2
1	.74	.73	.20	.73	.05	.15	.87	.90	.21	.44	.72	.51	.85	.46	.14	.66	.90	.83	.42	.89	.70	.24	.47	.520	.66	1
1880	.88	.68	.17	.72	.04	.24	.83	.80	.11	.40	.67	.45	.82	.42	.10	.63	.88	.73	.32	.85	.65	.22	.40	.490	.64	1880
79	.98	.66	.13	.70	.03	.29	.78	.73	.06	.37	.62	.38	.80	.39	.08	.59	.85	.63	.27	.79	.55	.19	.25	.470	.60	79
8	5.09	.60	.08	.67	.00	.33	.70	.64	65.99	.34	.57	.35	.74	.37	.06	.55	.82	.58	.21	.75	.50	.15	.14	.440	.56	8
7	.25	.55	.05	.65	27.97	.39	.59	.50	.93	.29	.54	.28	.70	.31	.03	.52	.79	.45	.10	.70	.44	.10	.00	.400	.52	7
6	.37	.50	.00	.63	.93	.44	.50	.40	.84	.24	.50	.25	.66	.24	96.99	.47	.75	.37	.04	.63	.39	.03	40.90	.350	.49	6
5	.47	.44	13.95	.61	.90	.50	.35	.29	.78	.20	.45	.18	.62	.19	.96	.43	.70	.30	40.96	.59	.33	.00	.80	.285	.46	5
4	5.57 0.02	.34	.90	.58	.87	.56	.23	.14	.66	.11	.42	.13	.58	.12	.94	.38	.66	.19	.85	.54	.24	42.95	.65	.225	.41	4
3	.10	.24	.82	.56	.85	.66	.15	51.94	.61	.04	.36	.02	.54	.00	.90	.34	.61	.04	.69	.49	.18	.87	.54	.160	.37	3
2	.22	.15	.74	.54	.81	.73	.03	.85	.56	37.98	.32	41.96	.49	71.93	.87	.32	.56	37.95	.60	.45	.11	.82	.45	.115	.35	2
1	.35	.07	.64	.51	.77	.82	35.09	.70	.53	.92	.26	.88	.44	.87	.84	.29	.48	.83	.52	.40	.06	.77	.30	.050	.28	1
1870	.52	25.99	.53	.48	.75	.91	.72	.55	.48	.83	.22	.80	.36	.80	.82	.26	.45	.69	.40	.35	41.97	.73	.22	.000	.24	1870
69	.76	.89	.39	.42	.70	3.12	.59	.40	.45	.75	.16	.74	.30	.75	.79	.22	.38	.56	.27	.30	.92	.69	.12	96.950	.20	69
8	1.00	.82	.31	.39	.64	.17	.40	.30	.39	.69	.12	.65	.24	.63	.76	.19	.35	.46	.15	.24	.83	.65	.02	.915	.17	8
7	.17	.74	.21	.35	.58	.41	.30	.07	.35	.56	.05	.58	.19	.55	.73	.15	.28	.35	39.95	.19	.77	.56	39.92	.850	.15	7
6	.37	.66	.16	.33	.53	.54	.17	50.94	.27	.48	.01	.50	.10	.47	.69	.11	.25	.25	.85	.13	.69	.52	.81	.780	.12	6
5	.50	.57	.10	.31	.49	.68	.03	.77	.20	.40	31.96	.42	.05	.43	.65	.07	.20	.11	.71	.08	.61	.47	.65	.725	.07	5
4	.62	.51	.04	.28	.46	.80	34.94	.64	.13	.33	.93	.35	43.99	.39	.62	.03	.17	.00	.63	.03	.55	.42	.51	.680	.03	4
3	.78	.45	12.96	.24	.43	.89	.85	.50	.08	.27	.89	.30	.94	.34	.58	35.97	.12	36.92	.53	36.96	.48	.38	.37	.645	30.97	3
2	.95	.39	.90	.22	.37	.98	.63	.40	.00	.21	.87	.25	.87	.26	.55	.92	.07	.85	.45	.90	.40	.34	.28	.600	.92	2
1	2.08	.35	.82	.16	.34	4.10	.51	.25	64.92	.15	.84	.18	.83	.19	.50	.85	.00	.74	.35	.81	.32	.25	.18	.550	.85	1
1860	.23	.28	.77	.14	.28	.21	.33	.14	.84	.12	.79	.13	.76	.13	.47	.77	62.93	.66	.24	.74	.25	.18	.10	.485	.82	1860
59	.40	.20	.69	.10	.24	.32	.16	49.94	.77	.00	.74	.06	.70	.08	.42	.70	.89	.56	.10	.70	.15	.10	38.99	.410	.77	59
8	.48	.16	.61	.08	.16	.44	.00	.78	.71	36.94	.70	40.99	.64	.02	.36	.64	.83	.44	.01	.64	.05	.03	.96	.355	.73	8
7	.66	.08	.52	.03	.12	.67	33.90	.64	.65	.87	.67	.94	.57	70.98	.30	.59	.76	.30	38.86	.59	40.96	41.95	.90	.300	.66	7
6	.90	24.99	.44	27.99	.08	.80	.78	.48	.59	.81	.57	.87	.52	.92	.28	.53	.70	.18	.75	.53	.89	.90	.86	.250	.61	6
5	3.12	.90	.35	.94	.00	5.00	.67	.28	.53	.74	.50	.81	.45	.87	.23	.47	.65	.07	.65	.48	.79	.83	.80	.190	.53	5
4	.38	.80	.29	.90	26.90	.14	.49	.10	.48	.68	.45	.75	.38	.79	.20	.42	.56	35.96	.53	.43	.69	.75	.73	.120	.50	4
3	.59	.69	.22	.86	.81	.35	.29	48.87	.46	.60	.38	.66	.32	.72	.16	.36	.47	.82	.39	.37	.59	.68	.70	.045	.43	3
2	.72	.59	.17	.84	.72	.53	.10	.70	.43	.50	.28	.59	.26	.66	.13	.30	.44	.70	.25	.31	.49	.60	.64	95.980	.36	2
1	.84	.58	.13	.78	.67	.74	32.98	.53	.40	.39	.20	.53	.23	.62	.11	.24	.36	.55	.10	.27	.40	.51	.54	.930	.29	1
1850	.96	.41	.09	.74	.59	.84	.83	.40	.35	.32	.15	.48	.18	.57	.08	.18	.31	.47	.01	.20	.33	.46	.43	.900	.26	1850
49	4.06	.32	.05	.68	.50	6.01	.70	.23	.30	.27	.07	.43	.15	.54	.05	.13	.25	.40	37.89	.15	.25	.41	.34	.855	.22	49
8	.13	.26	.02	.65	.44	.21	.55	.05	.25	.22	30.95	.37	.10	.48	.00	.07	.22	.29	.75	.11	.17	.34	.25	.830	.17	8
7	.24	.16	11.99	.63	.40	.35	.44	47.92	.20	.15	.85	.31	.05	.44	95.98	.02	.18	.17	.60	.07	.10	.25	.15	.790	.11	7
6	.36	.11	.95	.57	.36	.41	.32	.85	.15	.11	.75	.25	42.99	.40	.96	34.95	.14	.08	.54	.02	.05	.20	.05	.765	.06	6
5	.51	.06	.92	.54	.30	.51	25	.74	.09	.06	.69	.21	.94	.35	.92	.89	.10	.00	.43	35.98	39.97	.14	37.99	.745	.02	5
4	.66	23.98	.89	.50	.24	.57	.10	.65	.03	.00	.53	.16	.92	.32	.88	.81	.05	34.91	.35	.96	.90	.09	.89	.700	29.98	4
3	.80	.92	.86	.46	.19	.68	.01	.55	63.97	35.95	.40	.10	.87	.28	.85	.76	.02	.80	.24	.90	.82	.03	.71	.660	.93	3
2	.95	.85	.83	.40	.14	.80	31.91	.44	.92	.89	.25	.04	.82	.25	.82	.71	61.99	.72	.09	.88	.73	40.97	.55	.645	.89	2
1	5.09	.76	.80	.34	.06	.86	.83	.36	.85	.84	.15	.00	.78	.18	.79	.66	.94	.67	36.99	.84	.65	.93	.36	.565	.86	1
1840	.26	.70	.77	.30	.00	.93	.75	.28	.80	.79	.05	39.96	.75	.13	.75	.60	.87	.61	.90	.77	.60	.87	.31	.530	.83	1840
39	.44	.62	.74	.25	25.94	7.01	.59	.14	.75	.73	29.88	.91	.71	.05	.73	.55	.83	.53	36.79	.71	.53	.82	.18	.485	.78	39
8	.60	.54	.72	.18	.87	.12	.49	46.96	.68	.65	.79	.84	.67	69.98	.68	.47	.78	.42	.64	.66	.43	.74	.02	.440	.74	8
7	.75	.45	.68	.13	.82	.20	.35	.84	.59	.59	.66	.80	.62	.92	.66	.42	.70	.32	.50	.61	.35	.68	36.85	.390	.68	7
6	.90	.36	.65	.06	.74	.29	.10	.74	.50	.53	.46	.75	.58	.84	.64	.35	.63	.23	.36	.58	.25	.60	.74	.335	.66	6
5	6.01	.28	.62	.00	.68	.43	30.95	.61	.45	.45	.23	68	.54	.77	.61	.29	.57	.10	.18	.54	.15	.54	.64	.285	.60	5
4	.20	.23	.56	26.93	.61	.60	.75	.48	.35	.38	.05	.63	.50	.69	.57	.24	.51	.00	.04	.49	.07	.50	.58	.230	.54	4
3	.45	.18	.53	.86	.54	.75	.55	.34	.30	.31	28.90	.56	.45	.62	.55	.18	.45	33.88	35.88	.43	.00	.43	.47	.180	.52	3
2	.60	.11	.49	.82	.48	8.00	.34	.19	.24	.23	.70	.50	.40	.54	.52	.11	.36	.78	.70	.39	38.94	.36	.40	.140	.46	2
1	.80	.03	.44	.76	.41	.23	.15	.05	.19	.16	.53	.44	.36	.49	.48	.08	.29	.63	.54	.35	.87	.31	.30	.090	.41	1

TABLE I.—*Original scale readings, in centimeters, of Douglass's measurements, etc.*—Continued.

Year.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.	Year.
1830	6.96	22.99	11.40	26.66	25.36	8.40	29.95	45.90	63.13	35.09	28.43	39.38	42.34	69.45	95.45	34.02	61.26	33.50	35.40	35.32	38.80	40.20	36.24	95.060	29.35	1830
29	7.12	.94	.37	.62	.30	.62	.74	.75	.08	.02	.31	.30	.32	.37	.42	.00	.22	.34	.16	.28	.72	.13	.18	.010	.32	29
8	.35	.87	.35	.56	.25	.73	.64	.68	62.99	34.98	.20	.27	.30	.31	.39	33.95	.18	.25	.08	.25	.68	.05	.08	94.970	.28	8
7	.55	.82	.32	.49	.17	.90	.40	.55	.95	.90	.10	.22	.26	.26	.36	.90	.14	.15	34.90	.23	.61	39.97	.00	.925	.24	7
6	.75	.79	.26	.44	.12	9.01	.26	.45	.88	.83	.00	.17	.24	.20	.32	.84	.11	.05	.72	.20	.55	.89	35.95	.900	.19	6
5	.94	.76	.23	.39	.05	.16	.10	.29	.82	.76	27.89	.10	.20	.16	.30	.79	.08	32.95	.49	.16	.50	.82	.92	.870	.16	5
4	8.06	.73	.20	.36	.00	.27	28.99	.16	.75	.72	.78	.06	.13	.13	.27	.73	.04	.90	.31	.14	.45	.75	.76	.855	.12	4
3	.18	.70	.15	.30	24.96	.35	.79	.06	.68	.67	.69	.02	.08	.06	.25	.70	60.98	.81	.18	.11	.40	.71	.64	.805	.09	3
2	.33	.67	.10	.23	.92	43	.60	.00	.60	.63	.57	38.98	.04	.00	.22	D .64	.96	.73	.09	.09	.37	.62	.52	.770	.04	2
1	.44	.65	.06	.16	.87	.47	.45	44.90	.50	.56	.49	.93	.00	68.96	.18	.62	.91	.69	.03	.04	.30	.55	.41	.760	.00	1
1820	.56	.62	.01	.10	.84	.56	.34	.85	.43	.51	.38	.88	41.95	.93	.15	.58	.89	.60	33.87	.01	.25	.51	.34	.740	28.94	1820
19	.68	.60	10.96	.05	.79	.60	.25	.76	.31	.44	.28	.82	.90	.85	.12	.56	.85	.54	.76	34.98	.19	.46	.26	.705	.87	19
8	.75	.56	.93	25.97	.73	.72	.00	.72	.20	.41	.20	.80	.84	.78	.10	.51	.80	.39	.56	.95	.16	.42	10	.655	.83	8
7	.92	.52	.89	.92	.68	.76	27.70	.65	.10	.35	.10	.76	.77	.74	.05	.46	.77	.26	.45	.90	.12	.39	34.96	.605	.75	7
6	9.06	.49	.84	.85	.64	.80	.60	.54	.00	.28	26.98	.72	73	.71	.00	.42	.75	.14	.36	.86	.05	.36	.89	.550	.70	6
5	.31	.45	.80	.76	.59	.90	.40	.44	61.92	.22	.92	.66	.70	.63	94.92	.34	.72	31.90	.22	.83	37.98	.34	.75	.495	.65	5
4	.56	.40	.74	.64	.51	10.04	.15	.38	.83	.16	.76	.63	.64	.50	.86	.29	.65	.83	.06	.78	.90	.29	.62	.445	.60	4
3	.85	.35	.70	.52	.42	.18	26.96	.33	.73	.14	.62	.60	.58	.39	.80	.22	.61	.76	32.93	.71	.85	.21	.55	.390	.55	3
2	10.15	.31	.64	.40	.33	.26	.80	.24	.67	.07	.50	.58	.55	.26	.76	.16	.57	.65	.84	.69	.78	.16	.44	.350	.50	2
1	.44	.24	.58	.30	.24	.45	.69	.11	.63	33.98	.32	.52	.51	.19	.69	.10	.54	.41	.71	.67	.71	.09	.34	.290	.45	1
1810	.67	.16	.52	.18	.18	.69	.55	.00	.53	.91	.14	.47	.46	.13	.64	.05	.50	.31	.50	.64	.63	.03	.29	.235	.40	1810
09	10.86	.10	.49	.09	.13	.85	.25	43.90	.48	.82	.00	.40	.43	.04	.60	.00	.47	.15	.30	.59	.55	.00	.16	.200	.34	09
08	11.03	.03	.43	24.98	.06	11.04	.00	.86	.43	.75	25.90	.35	.37	67.96	.55	32.92	.43	.00	.12	.54	.48	38.94	.06	.150	.31	08
07	.27	21.97	.36	.86	23.99	.20	25.80	.69	.33	.70	.77	.31	.31	.89	.50	.85	.39	30.86	31.90	.51	.40	.87	33.95	.105	.27	07
06	.48	.92	.33	.75	.94	.34	.65	.59	.29	.63	.70	.26	.26	.83	.46	.80	.36	.72	.74	.48	.34	.82	.79	.080	.22	06
05	.71	.83	.27	.62	.87	.53	.38	.46	.20	.56	.62	.21	.20	.75	.42	.75	.34	.52	.57	.42	.25	.78	.66	.045	.18	05
04	.97	.75	.20	.49	.82	.71	.20	.35	.13	.51	.50	.16	.15	.71	.36	.68	.32	.39	.42	.37	.19	.71	.51	.005	.13	04
03	12.20	.66	.17	.40	.78	.86	.00	.26	.03	.45	.41	.13	.08	.66	.33	.63	.29	.25	.25	.34	.11	.67	.40	93.955	.08	03
02	38	.60	.13	.30	.74	12.05	24.73	.15	60.95	.37	.33	.06	40.99	.56	.29	.58	.27	.10	.14	.32	.02	.60	.30	.905	.04	02
01	.54	.53	.05	.18	.65	.25	.55	.09	.84	.32	.16	.02	.90	.50	.26	.52	.21	.00	30.99	.27	36.95	.50	.24	.860	27.98	01
1800	.66	.49	.02	.09	.60	.35	.28	42.99	.75	.27	.00	37.97	.84	.44	.20	.48	.17	29.80	.90	.24	.85	.45	.18	.820	.92	1800
1799	.91	.43	9.94	23.98	.53	.50	.12	.84	.67	.18	24.90	.92	.76	.38	.15	.41	.13	.55	.75	.22	.75	.39	.08	.750	.87	1799
8	13.20	.34	.86	.86	.43	.75	23.88	.72	.62	.11	.78	.89	.70	.30	.07	.36	.09	.38	.56	.19	.68	.31	.00	.700	.82	8
7	.48	.27	.79	.76	.35	.94	.57	.57	.54	.03	.69	.86	.65	.21	.00	.30	.03	.21	.45	.16	.60	.25	32.91	.655	.77	7
6	.74	.19	.74	.65	.28	13.13	.28	.44	.45	32.97	.60	.83	.60	.11	93.96	.23	59.98	.06	.30	.13	.51	.19	.75	.610	.75	6
5	14.04	.10	.64	.49	.19	.28	.12	.32	.32	.91	.50	.77	.52	.04	.93	.16	.93	28.94	.15	.09	.43	.10	.63	.580	.71	5
4	.44	.00	.57	.36	.12	.50	22.96	.22	.24	.82	.38	.72	.45	.00	.90	.10	.90	.80	.01	33.95	.34	.04	.54	.555	.65	4
3	.79	20.89	.50	.25	.05	.72	.83	.10	.18	.70	.25	.65	.41	66.95	.86	.05	.86	.60	29.80	.90	.25	.00	.49	.510	.63	3
2	15.00	.77	.45	.09	22.98	14.02	.70	.02	.04	.64	.15	.60	.34	.91	.82	.00	.82	.50	.57	.85	.20	37.95	.43	.460	.59	2
1	.20	.66	.40	22.95	.94	.25	.55	41.96	59.93	.58	.05	.55	.29	.87	.79	31.97	.78	.40	.43	.78	.16	.92	.36	.445	.55	1
1790	.31	.58	.36	.83	.90	.45	.25	.83	.82	.51	.00	.51	.25	.79	.76	.91	.73	.27	.30	.72	.11	.87	.25	.400	.52	1790
89	.60	.49	.29	.69	.86	.70	.05	.83	.77	.46	23.88	.46	.20	.76	.72	.85	.71	.16	.06	.64	.07	.80	.18	.355	.46	89
8	.77	.42	.25	.56	.80	.84	21.93	.72	.71	.39	.78	.42	.17	.73	.69	.81	.68	.05	28.95	.55	.02	.77	.08	.310	.44	8
7	16.05	.34	.22	.46	.76	15.03	.63	.59	.66	.30	.70	.35	.13	.65	.67	.76	.61	27.90	.80	.49	35.95	.73	31.99	.300	.41	7
6	.28	.26	.16	.28	.66	.20	.43	.53	.58	.26	.60	.30	.08	.61	.63	.69	.57	.75	.55	.40	.91	.62	.93	.260	.40	6
5	.64	.20	.13	.11	.60	.40	.34	.45	.51	.20	.48	.27	.04	.58	.61	.63	.55	.60	.38	.35	.84	.56	.80	.250	.37	3
4	.96	.14	.11	.00	.55	.59	.19	.26	.46	.09	.34	.20	39.95	.55	.57	.60	.53	.36	.25	.27	.75	.53	.70	.225	.33	4
3	17.13	.04	.08	21.90	.48	.85	.05	.15	.40	.00	.22	.15	.85	.52	.54	.54	.51	.22	.03	.23	.66	.47	.60	.190	.29	3
2	.39	19.96	.06	.80	.41	16.10	20.95	.10	.33	31.95	.13	.11	.80	.49	.50	.50	.47	.15	27.85	.18	.62	.43	.52	.145	.23	2
1	.58	.85	.04	.70	.34	.22	.85	.00	.27	.89	.02	.06	.75	.44	.45	.45	.44	.00	.77	.15	.56	.38	.43	.095	.16	1
1780	.78	.79	.00	.60	.28	.41	.65	40.94	.19	.84	22.93	.03	.67	.40	.39	.40	.41	26.91	.64	.10	.51	.33	.36	.050	.10	1780
79	18.00	.73	8.96	.45	.15	.55	.51	.83	.11	.79	.83	36.99	.60	.36	.34	.34	.35	.81	.49	.04	.46	.29	.30	.000	.06	79
8	.25	.66	.90	.33	.05	.70	.33	.75	.05	.74	.74	.95	.52	.34	.31	.28	.30	.67	.38	32.99	.40	.20	.20	92.940	.00	8
7	.48	.56	.84	.21	21.95	.80	.15	.66	58.95	.65	.65	.89	.45	.30	.26	.23	.25	.48	.24	.93	.33	.11	.07	.890	26.95	7
6	.65	.47	.77	.11	.89	17.00	.01	.56	.83	.59	.53	.82	.39	.24	.21	.17	.20	.24	.05	.82	.26	.06	30.95	.830	.90	6
5	.77	.39	.72	.04	.86	.18	19.80	.45	.70	.50	.35	.75	.30	.17	.15	.14	.15	.05	26.81	.72	.20	.03	.79	.770	.83	5
4	.91	.30	.65	20.94	.80	.34	.53	.35	.53	.40	.20	.70	.19	.12	.10	.06	.08	25.85	.60	.64	.13	36.95	.67	.715	.74	4
3	19.15	.20	.56	.84	.74	.56	.25	.26	.44	.34	.15	.65	.10	.05	.05	.00	.04	.71	.40	.60	.05	.89	.52	.645	.67	3
2	.41	.09	.48	.71	.68	.74	18.96	.14	.35	.25	.09	.58	38.98	65.95	.00	30.93	58.98	.64	.21	.54	34.95	.81	.39	.595	.22	2
1	.66	18.99	.39	.61	.65	.93	.60	39.97	.26	.15	.00	.52	.89	.88	92.93	.85	.90	.42	.00	.46	.86	.75	.22	.530	.54	1
1770	.87	.90	.36	.53	.61	18.09	.26	.85	.19	.09	21.93	.45	.80	.80	.85	.79	.84	.18	.81	.39	.76	.70	.12	.450	.48	1770
69	20.08	.83	.31	.39	.55	.23	17.90	.70	.10	30.99	.86	.39	.70	.70	.77	.73	.76	.02	.61	.30	.68	.63	.06	.400	.40	69
8	.33	.75	.20	.28	.50	.42	.62	.54	.00	.91	.76	.32	.63	.63	.72	.66	.68	24.80	.40	.22	.60	.56	29.96	.345	.34	8
7	.56	.66	.10	.14	.40	.68	.32	.35	57.94	.85	.69	.23	.56	.55	.66	.58	.61	.61	.20	.19	.51	.48	.86	.300	.28	7
6	.80	.59	7.99	19.95	.29	.96	.10	.19	.89	.76	.53	.15	.45	.45	.58	.47	.57	.33	24.93	.15	.39	.40	.76	.250	.22	6
5	21.15	.48	.88	.87	.19	19.16	16.85	39.00	.84	.67	.45	.08	.37	.36	.52	.39	.51	.04	.65	.11	.30	.33	.65	.220	.15	5
4	.45	.37	.76	.80	.05	.43	.58	38.80	.80	.55	.30	35.97	.32	.27	.45	.29	.46	23.70	.36	.05	.18	.23	.56	.150	.09	4
3	.80	.26	.64	.66	20.90	.73	.38	.64	.73	.50	.10	.90	.25	.18	.37	.23	.42	.40	.03	.00	.09	.12	.44	.100	.06	3
2	22.13	.15	.52	.55	.80	.90	.07	.46	.67	.36	20.93	.83	.19	.13	.31	.15	.36	.20	23.80	31.95	33.97	.05	.26	.050	.01	2
1	.48	.03	.44	.44	.70	20.05	15.70	.33	.60	.23	.79	.74	.11	.08	.27	.08	.30	22.95	.50	.90	.85	35.99	.12	.030	25.94	1
1760	.88	17.95	.36	.35	.51	.25	.42	.19	.48	.09	.60	.68	.04	.04	.23	.00	.28	.70	.23	.84	.75	.90	.02	91.990	.88	1760
59	23.32	.88	.26	.22	.36	.46	.23	.05	.35	.01	.49	.63	37.97	.00	.18	29.91	.24	.47	.03	.75	.67	.80	28.89	.950	.81	59
8	.73	.80	.20	.10	.26	.66	.07	37.86	.22	29.86	.39	.57	.90	64.96	.13	.86	.17	.20	22.80	.66	.58	.76	.75	.910	.76	8
7	24.04	.73	.16	.04	.16	.86	14.83	.71	.10	.78	.26	.50	.85	.94	.08	.79	.10	21.92	.60	.56	.50	.70	.63	.860	.66	7
6	.34	.69	.13	18.99	.01	21.05	.50	.64	.03	.70	.19	.46	.77	.89	.03	.71	.03	.56	.42	.50	.42	.59	.51	.840	.56	6
5	.61	.65	.09	.89	19.89	.23	.32	.50	56.94	.59	.10	.41	.66	.84	91.97	.63	57.95	.40	.33	.34	.32	.50	.40	.800	.49	5
4	.85	.60	.06	.82	.84	.36	.18	.35	.86	.45	.03	.37	.60	.76	.95	.55	.87	.20	.15	.15	.23	.35	.33	.740	.42	4
3	25.05	.56	.04	.77	.68	.46	.08	.23	.80	.35	19.90	.33	.54	.73	.89	.48	.84	20.95	21.94	.06	.10	.25	.21	.690	.36	3
2	.28	.48	6.98	.70	.51	.64	13.90	.17	.70	.17	.85	.28	.45	.63	.81	.39	.78	.72	.71	30.94	.00	.13	.15	.645	.29	2
1	.50	.40	.90	.61	.36	.81	.69	.05	.65	.05	.73	.24	.40	.50	.76	.29	.69	.58	.66	.85	32.86	.07	.02	.595	.21	1
1750	80	.32	.80	.54	.30	22.02	.30	36.90	.56	28.80	.65	.20	.30	.43	.71	.20	.63	.20	.44	.76	.72	34.93	27.92	.535	.13	1750
49	.94	.26	.76	.48	.24	.10	.15	.72	.53	.82	.57	.16	.20	.35	.65	.10	.57	19.85	.19	.67	.63	.87	.83	.470	.06	49
8	26.21	.21	.65	.39	.03	.25	12.86	.65	.43	.72	.50	.11	.14	.25	.60	.00	.50	.53	20.90	.60	.50	.75	.70	.435	.02	8
7	.47	.16	.51	.26	18.75	.50	.53	.45	.32	.57	.45	.05	.02	.16	.53	28.90	.45	.35	.75	.49	.37	.55	.59	.400	24.93	7
6	.82	.09	.44	.15	.50	.69	.22	.20	.26	.44	.41	.00	36.92	.06	.46	.79	.40	.05	.47	.39	.26	.45	.49	.340	.88	6
5	27.15	.05	.33	.04	.25	.90	11.98	.02	.17	.30	.34	34.95	.82	63.95	.42	.69	.35	18.64	.12	.24	.16	.38	.43	.305	.82	5
4	.54	16.98	.23	17.93	.04	23.10	.73	35.77	.11	.19	.25	.89	.75	.90	.35	.60	.31	.34	19.85	.05	.05	.26	.38	.240	.77	4
3	.87	.94	.15	.84	17.79	.25	.57	.50	.04	.02	.10	.81	.65	.82	.32	.53	.25	.08	.62	29.90	31.98	.16	.29	.160	.73	3
2	28.26	.87	.07	.76	.58	.42	.25	.28	.00	27.85	18.94	.74	.55	.76	.25	.43	.22	17.78	.34	.69	.85	.10	.10	.110	.68	2
1	.64	.80	5.96	.62	.41	.60	.10	.10	55.90	.70	.80	.69	.45	.66	.20	.37	.16	.53	.05	.54	.75	33.99	26.97	.060	.64	1
1740	.94 00.10	.74	.89	.51	.26	.72	10.71	34.90	.81	.58	.65	.64	.35	.64	.17	.28	.09	.25	18.71	.40	.69	.92	.80	.020	.58	1740
39	.43	.66	.77	.39	.05	.97	.50	.78	.67	.43	.53	.55	.26	.50	.13	.15	.07	.05	.45	.35	.61	.80	.63	90.970	.56	39
8	.64	.62	.67	.32	16.92	24.10	.15	.55	.51	.31	.39	.49	.20	.41	.09	.03	.03	16.78	.20	.05	.53	.66	.52	.935	.50	8
7	.83	.55	.57	.21	.75	.30	9.60	.40	.43	.22	.25	.42	.14	.33	.02	27.93	56.99	.40	17.89	28.89	.44	.57	.41	.870	.43	7
6	.98	.52	.50	.14	.68	.37	.25	.26	.30	.01	.14	.37	.09	.26	90.99	.85	.96	.06	.60	.75	.35	.50	.21	.820	.27	6
5	1.32	.46	.44	.04	.43	.64	8.95	.20	.23	26.85	18.00	.30	35.87	.18	.95	.73	.94	15.66	.33	.52	.20	.45	.05	.690	.12	5

TABLE I.—*Original scale readings, in centimeters, of Douglass's measurements, etc.*—Continued.

Year.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.	Year.
1734	1.58	16.41	5.37	16.96	16.28	24.82	8.65	32.03	55.15	26.60	17.82	34.25	35.66	63.14	90.90	27.63	56.88	15.47	17.18	28.30	31.02	33.28	25.86	90.560	23.99	1734
3	.83	.35	.32	.90	.09	25.07	.45	33.91	.00	.65	.70	.20	.54	.09	.80	.55	.84	.19	16.95	.15	30.85	.20	.70	.460	.85	3
2	2.08	.31	.26	.85	15.96	.23	7.95	.75	54.85	.39	.60	.15	.44	.00	.71	.45	.74	14.90	.67	.00	.74	.10	.59	.380	.76	2
1	.37	.26	.18	.80	.80	.39	.46	.61	.72	.28	.50	.07	.32	62.89	.65	.35	.63	.54	.40	27.80	.54	.01	.45	.310	.69	1
1730	.54	.22	.14	.76	.70	.50	6.97	.45	.62	.16	.38	.04	.21	.81	.58	.25	.56	.24	.20	.62	.43	32.80	.33	.250	.57	1730
29	.74	.15	.06	.71	.60	.60	.47	.37	.53	.04	.26	33.99	.09	.76	.53	.11	.47	13.82	15.95	.40	.30	.56	.20	.150	.49	29
8	.99	.09	.00	.67	.53	.72	5.98	.26	.40	25.82	.16	.95	34.97	.68	.47	26.98	.41	.66	.78	.20	.15	.36	.04	.090	.38	8
7	3.36	15.96	4.94	.60	.35	.90	.62	.14	.25	.54	.01	.86	.81	.60	.40	.85	.37	.48	.60	.00	.02	.19	24.92	89.960	.29	7
6	.70	.87	.86	.55	.22	26.04	.36	32.95	.05	.37	16.83	.77	.70	.50	.33	.74	.29	.23	.40	26.84	29.85	.07	.78	.890	.20	6
5	.96	.79	.80	.50	.10	.14	.05	.80	53.90	.13	.70	.72	.55	.39	.23	.56	.24	12.73	14.97	.60	.69	31.97	.63	.810	.14	5
4	4.26	.70	.71	.47	14.99	.30	4.61	.65	.79	24.95	.60	.65	.42	.30	.16	.45	.12	.05	.55	.35	.49	.80	.49	.740	.06	4
3	.47	.63	.64	.45	.91	.46	.29	.44	.65	.74	.38	.58	.32	.19	.10	.28	.07	11.68	.30	.17	.34	.67	.39	.650	22.97	3
2	.69	.54	.56	.42	.85	.75	3.94	.30	.50	.54	.17	.51	.21	.11	.05	.14	.01	.15	.00	25.92	.13	.48	.21	.550	.90	2
1	.95	.44	.46	.38	.76	.95	.77	.12	.37	.35	15.98	.43	.12	.02	89.98	25.99	55.96	10.70	13.70	.72	28.94	.34	.03	.470	.85	1
1720	5.17	.36	.36	.36	.64	27.11	.59	31.90	.27	.13	.88	.36	.04	61.93	.93	.84	.91	.23	.40	.57	.78	.20	23.86	.400	.75	1720
19	.40	.28	.25	.32	.46	.29	.40	.74	.06	23.95	.70	.28	33.92	.80	.86	.66	.86	9.70	.07	.39	.57	.09	.72	.285	.66	19
8	.60	.19	.17	.30	.38	.40	.25	.50	52.86	.77	.58	.20	.82	.70	.80	.50	.83	.35	12.82	.12	.33	30.96	.56	.170	.60	8
7	.85	.13	.10	.26	.29	.55	.11	.36	.68	.63	.45	.12	.74	.60	.71	.32	.79	8.92	.45	24.85	.08	.80	.40	.110	.55	7
6	6.11	.05	.03	.24	.24	.66	.00	.24	.54	.44	.33	.05	.65	.52	.65	.23	.75	.59	.18	.61	27.80	.66	.20	.040	.40	6
5	.37	14.97	3.95	.19	.13	.81	2.85	.08	.39	.27	.12	.00	.49	.40	.61	.10	.70	.19	11.90	.40	.57	.55	.00	88.930	.35	5
4	.64	.85	.88	.16	.02	.95	.68	30.92	.27	.12	14.93	32.93	.39	.29	.55	24.97	.65	7.75	.59	.14	.28	.40	22.85	.820	.14	4
3	.82	.77	.84	.11	13.86	28.06	.55	.71	.16	.02	.81	.85	.27	.18	.44	.85	.62	.38	.34	23.82	26.96	.19	.70	.715	.06	3
2	7.05	.68	.79	.07	.66	.17	.48	.54	.00	22.89	.65	.80	.22	.08	.37	.75	.54	.00	.06	.50	.65	.09	.56	.660	21.95	2
1	.27	.59	.74	.02	.46	.54	.37	.40	51.89	.73	.45	.71	.15	60.92	.30	.60	.47	6.64	10.85	.27	.31	29.97	.42	.555	.85	1
1710	.48	.50	.70	15.98	.25	.74	.25	.28	.77	.67	.29	.65	.05	.78	.25	.47	.38	.20	.64	22.96	25.90	.81	.26	.460	.75	1710
09	.67	.46	.64	.95	.09	.87	.19	.10	.68	.55	.14	.58	32.95	.66	.12	.36	.33	5.78	.28	.54	.50	.60	.13	.360	.66	09
8	.90	.40	.56	.92	12.95	29.13	.12	29.96	.58	.35	13.96	.53	.87	.59	.05	.27	.28	.43	.04	.30	.13	.45	21.95	.280	.60	8
7	8.15	.34	.48	.89	.70	.35	.05	.84	.40	.18	.80	.40	.78	.47	.00	.18	.20	.14	9.85	21.93	24.65	.37	.78	.190	.53	7
6	.40	.28	.42	.86	.44	.61	1.87	.64	.27	.05	.60	.30	.72	.32	88.91	.14	.13	4.75	.70	.64	.22	.24	.65	.120	.45	6
5	.66	.22	.36	.85	.26	.75	.76	.35	.16	21.91	.45	.22	.54	.22	.82	.07	.08	.36	.35	.36	23.86	.15	.45	.050	.35	5
4	.92	.14	.29	.84	.10	.90	.70	.16	.06	.79	.30	.17	.47	.09	.75	23.99	.00	3.95	.03	.04	.51	.04	.30	87.980	.23	4
3	9.14	.05	.21	.80	11.95	30.05	.60	.01	50.96	.65	.24	.11	.39	59.96	.67	.92	54.94	.63	8.79	20.74	.07	28.86	.16	.900	.11	3
2	.33	13.97	.14	.77	.81	.18	.40	28.79	.85	.50	.15	.03	.29	.83	.60	.82	.89	.32	.59	.39	22.70	.71	.10	.830	.00	2
1	.51	.86	.06	.74	.71	.27	.....	.54	.75	.35	.05	31.92	.20	.70	.53	.75	.84	2.93	.26	.15	.33	.60	.02	.750	20.90	1
1700	.79	.77	2.99	.66	.60	.37	.....	.35	.64	.18	12.88	.84	.11	.58	.45	.65	.76	.58	.00	19.91	21.75	.52	20.94	.660	.82	1700
1699	10.04	.68	.94	.56	.45	.42	.....	.15	.57	.05	.73	.74	.01	39	.35	.56	.70	.18	7.70	.65	.26	.38	.85	.600	.72	1699
8	.31	.61	.86	.49	.27	.50	.....	27.97	.47	20.90	.60	.66	31.90	.24	.27	.47	.65	1.90	.43	.44	20.92	.19	.75	.540	.62	8
7	.56	.56	.78	.42	.10	.53	.....	.78	.41	.75	.40	.60	.80	.06	.19	.39	.60	.70	.13	.20	.51	.07	.62	.440	.53	7
6	.79	.49	.66	.34	10.88	.60	.....	.65	.26	.56	.25	.52	.72	58.94	.06	.30	.55	.50	6.89	18.96	.15	27.90	.50	.350	.45	6
5	.96	.41	.49	.25	.70	.85	.....	.47	.17	.44	.07	.44	.62	.81	87.94	.21	.50	.33	.70	.61	19.80	.73	.39	.260	.36	5
4	11.11	.33	.36	.19	.55	.97	.....	.26	49.96	.30	11.95	.36	.50	.63	.81	.10	.41	.13	.45	.26	.55	.60	.29	.180	.29	4
3	.35	.20	.19	.11	.32	31.05	.....	.08	.77	.16	.80	.31	.39	.49	.72	.00	.33	0.97	.07	17.90	.40	.38	.20	.070	.16	3
2	.56	.07	.06	.05	.13	.14	.....	26.90	.65	.04	.68	.24	.30	.34	.62	22.93	.27	.66	5.83	.52	.34	.19	.10	86.950	.08	2
1	.88	12.98	1.90	14.98	9.96	.30	.....	.73	.53	19.89	.49	.18	.19	.25	.49	.89	.23	.....	.48	.17	.05	.05	.02	.850	19.92	1
1690	12.17	.88	.79	.94	.70	.....	.....	.57	.36	.74	.29	.11	.05	.14	.37	.85	.18	.....	.15	16.80	18.60	26.90	19.89	.720	.79	1690
89	.48	.78	.62	.88	.45	.....	.....	.39	.25	.59	.08	.04	30.96	.06	.27	.82	.08	.....	4.83	.51	.00	.76	.80	.550	.68	89
8	.83	.70	.47	.84	.20	.....	.....	.19	.06	.50	10.93	30.97	.85	.01	.10	.77	.04	.....	.52	.18	17.60	.63	.70	.450	.55	8
7	13.08	.64	.39	.81	.06	.....	.....	25.96	48.86	.44	.85	.92	.75	57.90	86.90	.72	53.94	.....	.26	15.85	.30	.43	.65	.340	.43	7
6	.24	.57	.30	.77	8.91	.....	.....	.85	.70	.34	.74	.87	.65	.75	.76	.66	.85	.....	.03	.55	.00	.27	.60	.230	.35	6
5	.39	.50	.22	.75	.76	.....	.....	.73	.56	.22	.60	.82	.55	.57	.60	.60	.78	.....	3.89	.25	16.66	.04	.52	.110	.24	5
4	.56	.38	.09	.67	.56	.....	.....	.57	.50	.13	.45	.75	.35	.37	.45	.55	.70	.....	.73	14.86	.22	25.70	.45	85.980	.09	4
3	.70	.29	1.00	.60	.41	.....	.....	.39	.40	18.97	.30	.70	.20	.16	.34	.50	.65	.....	.50	.51	15.90	.55	.40	.830	18.97	3
2	.83	.20	0.88	.56	.22	.....	.....	.17	.31	.77	.16	.62	.13	56.96	.18	.46	.58	.....	.29	.22	.40	.35	.31	.715	.85	2
1	14.01	.09	.77	.47	.07	.....	.....	24.92	.25	.52	.00	.53	.05	.80	.00	.42	.51	.....	.06	13.84	14.91	.18	.20	.640	.76	1
1680	.23	11.96	.66	.39	7.96	.....	.....	.65	.19	.47	9.82	.48	29.98	.65	85.88	.37	.43	.....	2.77	.47	.40	.05	.03	.560	.64	1680
79	.53	.80	.52	.34	.77	.....	.....	.43	.07	.33	.62	.41	.92	.49	.80	.31	.36	.....	.51	.09	13.86	24.85	18.90	.490	.55	79
8	.75	.69	.41	.27	.62	.....	.....	.16	47.98	.21	.46	.35	.84	.22	.74	.25	.31	.....	.28	12.70	.40	.64	.79	.410	.44	8
7	.92	.59	.30	.21	.48	.....	.....	23.93	.87	.08	.29	.30	.74	.00	.66	.20	.28	.....	.05	.36	12.89	.45	.66	.340	.33	7
6	15.05	.50	.19	.16	.27	.....	.....	.71	.77	17.86	.11	.21	.62	55.79	.58	.15	.22	.....	1.84	.10	.39	.27	.54	.210	.20	6
5	.30	.39	0.03 27.27	.07	.05	.....	.....	.45	.65	.75	8.95	.13	.52	.64	.50	.08	.18	.....	.66	11.84	11.89	.15	.43	.070	.06	5
4	.53	.32	.16	.02	6.90	.....	.....	.08	.55	.67	.85	.08	.42	.45	.43	.02	.12	.....	.40	.44	.40	.02	.35	84.940	17.93	4
3	.78	.27	.07	13.98	.77	.....	.....	22.80	.43	.63	.73	.04	.25	.28	.30	21.95	.06	.....	.16	.00	10.95	23.87	.25	.760	.80	3
2	16.04	.24	26.98	.95	.70	.....	.....	.59	.34	.59	.60	29.99	.14	.10	.19	.90	52.95	.....	.08	10.60	.75	.70	.17	.600	.67	2
1	.19	.19	.95	.91	.60	.....	.....	.43	.20	.53	.53	.97	.05	54.91	.06	.80	.87	.....	0.93?	.20	.58	.57	.14	.500	.55	1
1670	.39	.16	.87	.85	.40	.....	.....	.33	.10	.45	.35	.94	28.94	.68	84.92	.66	.76	.....	.83?	9.70	.27	.40	.05	.350	.40	1670
69	.64	.09	.77	.80	.08	.....	.....	.17	.00	.32	.15	.91	.80	.44	.79	.54	.70	.....	.70?	.25	.992.	.25	17.96	.200	.28	69
8	.86	.00	.67	.75	5.78	.....	.....	.04	46.94	.19	7.98	.86	.73	.24	.65	.41	.59	.....	.58?	8.87	.58	.05	.90	.090	.21	8
7	17.08	10.92	.58	.69	.42	.....	.....	21.86	.85	.06	.85	.81	.68	53.96	.55	.29	.51	.....	.40?	.53	.18	22.82	.75	83.960	.10	7
6	.31	.81	.46	.57	.03	.....	.....	.67	.75	16.90	.75	.77	.60	.71	.44	.18	.45	.....	.19?	.25	8.69	.66	.67	.880	16.99	6
5	.62	.70	.29	.46	4.64	.....	.....	.48	.62	.70	.63	.72	.50	.51	.34	.09	.36	.....	.....	.03	.30	.48	.62	.780	.89	5
4	.93	.56	.10	.36	.35	.....	.....	.25	.47	.55	.52	.66	.41	.30	.25	.00	.29	.....	.....	7.75	7.97	.34	.55	.650	.76	4
3	18.26	.39	25.94	.26	.03	.....	.....	.00	.39	.40	.45	.58	.34	.07	.15	20.93	.24	.....	.....	.44	.69	.16	.45	.560	.60	0
2	.63	.24	.75	.19	3.64	.....	.....	20.83	.28	.23	.35	.53	.23	52.89	.03	.84	.16	.....	.....	6.96	.49	.02	.39	.450	.45	2
1	.94	.16	.56	.14	.40	.....	.....	.61	.15	15.95	.19	.48	.14	.74	83.94	.74	.09	.....	.....	.78	.28	21.93	.30	.270	.28	1
1660	19.18	.12	.38	.04	.13	.....	.....	.41	.06	.80	.04	.44	.05	.58	.84	.58	51.98	.....	.....	.38	.02	.81	.20	.150	.17	1660
59	.36	.08	.21	12.96	2.81	.....	.....	.20	45.94	.65	6.86	.39	.00	.42	.68	.44	.86	.....	.....	.15	6.81	.70	.11	82.960	.06	59
8	.50	.06	.05	.92	.63	.....	.....	.05	.77	.31	.70	.36	27.95	.30	.55	.30	.75	.....	.....	5.85	.60	.58	.05	.840	15.93	8
7	.70	.02	24.85	.85	.45	.....	.....	19.83	.64	.20	.54	.33	.86	.17	.40	.15	.65	.....	.....	.60	.36	.44	16.95	.720	.77	7
6	19.92 20.17	9.96	.70	.79	.22	.....	.....	.65	.44	.05	.40	.29	.79	51.96	.28	.00	.58	.....	.....	.30	.10	.25	.90	.600	.66	6
5	40	.86	.54	.75	2.00	.....	.....	.47	.24	14.85	.30	.25	.69	.76	.20	19.93	.50	.....	.....	.01	5.85	.00	.84	.470	.55	5
4	.60	.80	.37	.72	1.77	.....	.....	.35	.00	.65	.25	.22	.60	.57	.09	.81	.45	.....	.....	4.70	.67	20.73	.80	.220	.42	4
3	.80	.74	.21	.64	.48	.....	.....	.15	44.80	.45	.23	.16	.52	.42	82.99	.68	.31	.....	.....	.36	.40	.53	.76	.060	.28	3
2	.91	.67	.09	.56	.25	.....	.....	18.86	.69	.26	.21	.12	.44	.33	.82	.52	.19	.....	.....	.15	.27	.36	.72	81.900	.10	2
1	21.09	.61	23.96	.50	.10	.....	.....	.55	.60	.09	.10	.10	.35	.20	.65	.38	.05	.....	.....	3.86	.12	.16	.66	.700	14.96	1
1650	.27	.36	.93	.44	0.87	.....	.....	.30	.42	13.95	.03	.07	.28	.08	.50	.25	50.93	.....	.....	.60	.05	.01	.60	.480	.85	1650
49	.36	.33	.77	.40	.66	.....	.....	.10	.25	.81	5.97	.03	.22	50.90	.31	.12	.84	.....	.....	.36	.00	19.75	.56	.250	.75	49
8	.52	.23	.61	.34	.32	.....	.....	17.92	.18	.66	.88	.01	.17	.67	.17	.01	.73	.....	.....	.15	4.85	.49	.50	.050	.64	8
7	.74	.10	.50	.30	0.05 10.05	.....	.....	.70	.06	.40	.77	28.96	.14	.40	81.96	18.88	.65	.....	.....	2.95	.68	.23	.45	80.890	.49	7
6	22.04	8.98	.31	.19	9.73	.....	.....	.50	43.92	.20	.68	91	.03	.14	.80	.79	.60	.....	.....	.83	.56	18.74	.40	.740	.35	6
5	.41	.87	.10	.10	.45	.....	.....	.20	.77	12.95	.55	.88	26.92	49.88	.70	.69	.53	.....	.....	.70	.43	.58	.35	.600	.14	5
4	.62	.75	22.86	.07	.25	.....	.....	16.86	.64	.76	.40	.84	.84	.60	.59	.59	.45	.....	.....	.60	.24	.23	.30	.440	.04	4
3	.88	.60	.60	.03	.00	.....	.....	.54	.54	.63	.30	.79	.79	.45	.44	.50	.35	.....	.....	.45	.00	17.97	.25	.280	13.90	3
2	23.20	.51	.41	11.96	8.86	.....	.....	.19	.40	.49	.17	.74	.70	.33	.30	.39	.25	.....	.....	.38	.....	.79	.20	.100	.77	2
1	.63	.43	.18	.90	.60	.....	.....	15.81	.25	.20	.03	.68	.58	.23	.19	.30	.17	.....	.....	.25	.....	.55	.14	79.920	.64	1

TABLE I.—*Original scale readings, in centimeters, of Douglass's measurements, etc.*—Continued.

Year.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.	Year.
1640	23.95	8.36	21.95	11.81	8.50			15.43	43.08	11.96	4.86	28.65	24.48	49.10	81.04	18.20	50.05			1.90		17.29	16.09	79.700	13.49	1640
39	24.31	.26	.78	.70	.20			.15	42.95	.80	.70	.62	.39	48.91	80.95	.11	49.96			.70		.05	.00	.480	.34	39
8	.70	.17	.64	.64	.00			14.88	.85	.59	.50	.53	.33	.73	.83	.02	.81					16.80	15.91	.200	.08	8
7	25.26	.12	.41	.60	7.82			.67	.67	.38	.30	.46	.18	.57	.70	17.92	.75					.53	.85	78.990	12.93	7
6	.78	.05	.20	.47	.70			.50	.40	.20	.14	.39	.10	.41	.55	.82	.63					.36	.72	.770	.80	6
5	26.52	7.95	.00	.37	.53			.27	.08	.04	3.92	.32	.04	.21	.41	.73	.49					.03	.62	.490	.56	5
4	.92	.80	20.80	.32	.30			.13	41.77	10.96	.80	.26	25.90	.00	.29	.65	.37					15.76	.52	.140	.35	4
3	27.36	.72	.60	.27	.15			13.89	.47	.72	.65	.23	.75	47.80	.15	.54	.23					.45	.42	77.800	11.95	3
2	.66	.65	.30	.22	7.00			.77	.20	.50	.50	.17	.60	.54	79.87	.44	.15					.09	.34	.570	.74	2
31	28.15	.59	.00	.16				.56	40.90	.31	.43	.07	.45	.36	.65	.35	.00					14.80	.30	.300	.43	31
1630	.69	.55	19.72	.09				.34	.73	.15	.35	27.98	.26	.12	.50	.25	48.80					.49	.21	76.900	.15	1630
29	29.10	.43	.46	.03				.04	.52	.05	.24	.89	.10	46.87	.28	.10	.55					.15	.14	.630	10.95	29
8	29.35	.29	.22	10.96				12.79	.40	9.89	.13	.84	.00	.64	78.95	16.94	.40					13.85	.06	.250	.73	8
7		.19	18.98	.90				.41	.19	.74	.02	.80	24.90	.42	.60	.85	.25					.60	14.97	75.850	.55	7
6		.07	.62	.86				.11	.00	.57	2.90	.70	.80	.09	.23	.70	.07					.34	.89	.500	.45	6
5		6.97	.30	.78				11.77	39.66	.64	.83	.58	.75	45.72	77.73	.54	47.91					12.90	.85	.250	.26	5
4		.80	.05	.73				.45	.39	.07	.70	.53	.67	.45	.49	.38	.83					.45	.80	.050	.10	4
3		.60	17.78	.65				.16	.25	8.75	.64	.44	.55	.08	.24	.25	.72					11.98	.70	74.850	9.87	3
2		.43	.43	.56				10.80	.06	.44	.53	.35	.39	44.74	.03	.11	.60					.50	.63	.700	.60	2
1		.26	.10	.47				.37	38.90	.00	.43	.27	.20	.44	76.76	.02	.50					.00	.53	.460	.36	1
1620		.10	16.71	.40				9.94	.72	7.53	.34	.20	.06	.13	.57	15.95	.38					10.54	.48	.270	.21	1620
19		5.96	.37	.34				.51	.56	.23	.22	.11	23.95	43.85	.35	.69	.23					.16	.40	.040	.07	19
8		.79	15.97	.26				.04	.36	.05	.16	.01	.79	.53	.15	.45	.04					9.76	.28	73.850	8.91	8
7		.59	.57	.21				8.65	.22	6.72	.00	26.93	.67	.38	75.92	.23	46.90					.54	.14	.650	.85	7
6		.41	.20	.17				.25	.12	.32	1.87	.89	.55	.21	.75	.07	.75					.14	.00	.460	.63	6
5		.24	14.77	.12				7.93	37.85	.05	.80	.80	.40	.06	.56	14.90	.55					8.84	13.89	.250	.54	5
4		.06	.46	.06				.61	.69	5.80	.72	.74	.32	42.80	.36	.75	.43					.44	.72	.050	.47	4
3		4.87	.06	.00				.34	.50	.52	.65	.67	.25	.64	.12	.64	.27					.05	.60	72.850	.42	3
2		.70	13.69	9.94				.00	.37	.20	.60	.60	.12	.46	74.90	.52	.10					7.75	.47	.560	.24	2
1		.52	.10	.85				6.70	.05	4.95	.54	.50	.00	.26	.56	.38	.00					.51	.36	.380	.08	1
1610		.33	12.90	.73				.42	36.80	.80	.50	.38	22.90	.09	.30	.26	45.90					.21	.28	.160	7.91	1610
9		.13		.66				.15	.55	.62	.46	.28	.78	41.96	.03	.11	.83					6.95	.20	.060	.74	9
8		3.98		.59				5.91	.42	.43	.41	.20	.69	.80	73.82	.05	.63					.66	.02	71.730	.45	8
7		.77		.54				.70	.35	.29	.31	.08	.55	.56	.60	13.82	.48					.35	12.79	.440	.23	7
6		.57		.48				.50	.24	.13	.20	.00	.40	.45	.23	.60	.30					.13	.61	.200	6.99	6
5		.40		.42				.33	.00	3.90	.10	25.90	.29	.37	72.92	.45	.15					5.89	.50	.000	.79	5
4		.19		.36				.03	35.74	.70	.02	.80	.23	.34	.67	.25	.00					.73	.40	70.740	.57	4
3		2.96		.32				4.80	.55	.50	0.85	.69	.15	.08	.36	.10	44.82					.31	.20	.500	.35	3
2		.69		.29				.60	.44	.35	0.70	.60	.00	40.81	.13	12.95	.62					4.94	.07	.200	.10	2
1		.40		.27				.40	.34	.06		.44	21.88	.60	71.88	.75	.47					.64	.01	.070	5.90	1
1600		.10		.25				.27	.14	2.86		.34	.79	.43	.40	.60	.36					.37	11.89	69.900	.70	1600
1599		1.85		.14				3.91	34.96	.71		.23	.74	.39	.19	.50	.24					.11	.78	.770	.58	1599
8		.48		.07				.60	.80	.53		.10	.65	.10	.00	.40	.04					3.90	.59	.530	.40	8
7				.03				.36	.68	.46		.00	.60	39.82	70.72	.15	43.84					.65	.45	.300	.10	7
6				8.96				.13	.51	.20		24.86	.52	.65	.35	11.90	.70					.44	.32	.050	4.90	6
5				.88				2.90	.39	1.99		.75	.43	.54	.09	.74	.55					.36	.21	68.900	.73	5
4				.84				.75	.25	.85		.68	.36	.46	69.74	.60	.50					.06	.04	.800	.61	4
3				.79				.60	.15	.75		.65	.27	.36	.49	.55	.38					2.86	10.84	.700	.52	3
2				.75				.45	.05	.66		.58	.19	.22	.35	.50	.18					.62	.69	.450	.37	2
1				.73				.33	33.97	.55		.47	.10	.10	.13	.33	42.98					.40	.52	.250	.16	1
1590				.71				.22	.87	.37		.40	.00	.00	68.80	.18	.83					.28	.40	.050	.03	1590
89				.62				.00	.78	.20		.35	20.96	38.80	.54	10.90	.67					.23	.22	67.830	3.85	89
8				.56				1.84	.50	.05		.32	.87	.64	.29	.70	.54					.10	.12	.650	.68	8
7				.46				.68	.35	0.85		.27	.77	.40	.06	.54	.37					1.91	.09	.500	.48	7
6				.42				.45	.12	.75		.23	.70	.30	67.80	.35	.20					.78	.05	.290	.18	6
5				.41				.40	32.95	.60		.16	.52	.10	.60	.08	.07					.69	9.88	.100	2.99	5
4				.36				.30	.80	.40		.13	.33		.23	9.93	41.93					.62	.65	66.970	.82	4
3				.30				.19	.63			.08	.26		.04	.76	.73					.52	.35	.810	.58	3
2				.22				.06	.43			.03	.01		66.73	.60	.55					.34	.09	.650	.22	2
1				.14				1.00	.20			23.95	19.89		.36	.40	.30					.25	8.84	.430	.05	1
1580				.04				0.92	.04			.91	.80		.11	.18	.07					.14	.55	.150	1.90	1580
79				7.90				.86	31.87			.87	.73		65.80	8.90	40.90					.03	.30	.030	.62	79
8				.80				.77	.74			.82	.67		.45	.79	.64					0.94	.18	65.850	.49	8
7				.71				.40	.61			.80	.60		.11	.50	.32					.83	.09	.630	.33	7
6				.66					.50			.71	.55		64.83	.17	.14					.72	7.88	.470	.20	6
5				.59					.42			.63	.47		.50	7.91	39.90					.67	.63	.300	.05	5
4				.51					.26			.59	.37		.23	.70	.63					.57	.41	.190	0.73	4
3				.41					.08			.48	.30		63.92	.43	.44					.45	.21	.050		3
2				.31					30.91			.37	.18		.66	.20	.20					.20	.04			2
1				.23					.71			.32	.04		.30	6.93	38.96					.20	6.87			1
1570				.13					.55			.25	18.90		.00	.72	.81					.10	.69			1570
69				.01					.40			.15	.76		62.81	.53	.75						.51			69
8				6.95					.16			.05	.62		.65	.30	.50						.40			8
7				.86					.00			22.95	.46		.49	.05	.39						.21			7
6				.74					29.86			.85	.38		.25	5.85	.22						.05			6
5				.57					.75			.78	.30		.14	.51	.10						5.92			5
4				.46					.63			.68	.16		61.98	.25	37.90						.77			4
3				.36					.46			.59	.10		.91	.00	.74						.60			3
2				.28					.35			22.56	.00		.71	4.71	.43						.40			2
1				.16					.24			.47	17.93		.53	.45	.04						.20			1
1560				.05					.14			.42	.85		.40	.15	36.84						.05			1560
59				5.97					28.95			.33	.73		.25	3.92	.61						4.95			59
8				.83					.77			.23	.66		.11	.67	.31						.80			8
7				.68					.67			.20	.62		.00	.38	.15						.65			7
6				.45					.62			.14	.54		60.89	.15	35.95						.50			6
5				.20					.50			.07	.45		.80	2.98	.70						.37			5
4				.04					.40			21.98	.35		.50	.80	.55						.22			4
3				4.89					.37			.85	.30			.67	.33						.09			3
2				.75					.34			.73	.25			.55	.15						3.91			2
1				.54					.28			.65	.22			.40	34.90						.73			1
1550				.36					.20			.56	.16			.30	.70						.53			1550
49				.24					.13			.51	.06			.16	.43						.39			49
8				.11					.04			.42	.00			.02	.16						.21			8
7				3.90					.00			.37	16.94			1.90	33.95						.02			7
6				.83					27.90			.29	.87			.81	.75						2.88			6
5				.69					.76			.21	.77			.69	.40						.74			5
4				.54					.67			.15	.70			.54	.13						.64			4

TABLE I.—*Original scale readings, in centimeters, of Douglass's measurements, etc.*—Continued.

Year.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.	Year.
1543				3.43					27.63			21.05	16.65			1.45	32.90						2.60			1543
2				.24					.57			20.96	.60			.40	.70						.56			2
1				.13					.51			.93	.51			.34	.50						.46			1
1540				.00					.43			.88	.43			.10	.28						.34			1540
39				2.80					.34			.81	.35				.00						.22			39
8				.55					.22			.76	.27				31.66						.15			8
7				.35					.08			.73	.23				.45						.05			7
6				.20					.00			.67	.16				.23						1.92			6
5				.01					26.93			.63	.06				30.97						.80			0
4				1.86					.87			.57	15.96				.65						.68			4
3				.60					.82			.51	.85				.44						.53			3
2				.34					.76			.45	.79				.20						.39			2
1				.14					.69			.41	.67				.00						.30			1
1530				0.95					.63			.32	.60				29.75						.17			1530
29				.50					.57			.26	.48				.55						1.03			29
8				.38					.50			.21	.34				.30						0.85			8
7									.46			.18	.19				.08						.68			7
6									.40			.15	.13				28.94						.57			6
5									.33			.10	.03				.75						.47			5
4									.26			.04	14.89				.55						.38			4
3									.20			19.95	.80				.38						.25			3
2									.10			.88	.69				.16						.12			2
1									25.97			.83	.50				27.94						.05			1
1520									.95			.77	.45				.73									1520
19												.67	.38				.50									19
8												.61	.20				.40									8
7												.54	.05				.27									7
6												.47	13.92				.10									6
5												.39	.85				.00									5
4												.32	.70				26.90									4
3												.23	.60				.80									3
2												.15	.46				.70									2
1												.05	.21				.63									1
1510												.01	.05				.50									1510
09												18.95	12.92				.40									09
8												.82	.85				.30									8
7												.77	.80				.20									7
6												.65	.66				.10									6
5												.53	.60													5
4												.45	.48													4
3												.30	.39													3
2												.18	.05													2
1												.09	11.90													1
1500												.02	.72													1500
1499												17.89	.54													1499
8												.82	.37													8
7												.74	.22													7
6												.63	.10													6
5												.53	.00													5
4												.45	10.82													4
3												.40	.69													3
2												.37	.54													2
1												.30	.45													1
1490												.24	.24													1490
89												.15	.13													89
8												.09	.00													8
7												16.98	9.85													7
6												.89	.77													6
5												.80	.73													5
4												.69	.55													4
3												.59	.35													3
2												.48	.27													2
1												.38	.13													1
1480												.30	.04													1480
79												.20	8.90													79
8												.05	.70													8
7												15.96	.54													7
6												.90	.44													6
5												.74	.32													5
4												.63	.14													4
3												.52	7.90													3
2												.36	.75													2
1												.23	.60													1
1470												.12	.50													1470
69												14.95	.36													69
8												.80	.25													8
7												.70	.15													7
6												.61	.05													6
5												.54	6.95													5
4												.44	.87													4
3												.31	.80													3
2												.20	.70													2
1												.13	.60													1
1460												.02	.57													1460
59												13.88	.50													59
8												.75	.39													8
7												.62	.30													7
6												.52	.23													6
5												.30	.09													5
4												.25	5.95													4
3												.15	.87													3
2												.05	.74													2
1												12.93	.64													1
1450												.80	.52													1450
49												.75	.41													49
8												.70	.34													8

TABLE I.—*Original scale, in centimeters, of Douglass's measurements, etc.*—Continued.

Year.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.	Year.
1447												12.55	5.25													1447
6												.38	.18													6
5												.23	.09													5
4												.14	4.90													4
3												11.98	.78													3
2												.83	.74													2
1												.50	.65													1
1440												.35	.56													1440
39												.20	.35													39
8												.00	.24													8
7												10.85	.14													7
6												.61	.04													6
5												.41	3.90													5
4												.21	.75													4
3												.06	.66													3
2												9.85	.56													2
1												.65	.50													1
1430												.46	.39													1430
29												.30	.12													29
8												.10	.00													8
7												8.93	2.86													7
6												.78	.73													6
5												.43	.59													5
4												.04	.42													4
3												7.83	.27													3
2												.54	.05													2
1												.19	1.80													1
1420												6.92	.59													1420
19												.70	.40													19
8												.50	.20													8
7												.32	1.00													7
6												.00	0.80													6
5												5.75	.65													5
4												.50	.25													4
3												.25	.13													3
2												.00	0.00													2
1												4.67														1
1410												.41														1410
09												.20														09
8												3.95														8
7												.69														7
6												.45														6
5												.30														5
4												2.95														4
3												.65														3
2												.42														2
1												.13														1
1400												.09														1400
1399												1.70														1399
8												.55														8
7												.50														7
6												.45														6
5												.30														5
4												1.00														4
3												0.70														3
1392												0.10														1392

Table 2 gives the averages of the yearly growths for three groups of trees, X, Y, Z. The measurements are all expressed in millimeters. The second and third groups, Y and Z, represent trees selected for their great age from the 25 of the first group X.

TABLE 2.—*Averages of the yearly growth for the three age-groups of trees.*

Year.	Average growth.			Year.	Average growth.		
	X Group of 25.	Y Group of 7.	Z Group of 2.		X Group of 25.	Y Group of 7.	Z Group of 2.
	Mm.	*Mm.*	*Mm.*		*Mm.*	*Mm.*	*Mm.*
1906	(0.768)	(0.63)	0.45	1887	0.588	0.49	0.45
1905	(0.572)	(0.37)	0.40	1886	0.556	0.47	0.40
1904	(0.520)	(0.53)	0.50	1885	0.608	.049	0.50
1903	(0.740)	0.56	0.50	1884	0.532	0.43	0.45
1902	0.492	0.41	0.45	1883	0.516	0.43	0.45
1901	0.648	0.44	0.45	1882	0.492	0.49	0.45
				1881	0.524	0.46	0.45
1900	0.564	0.33	0.30				
1899	0.632	0.50	0.50	1880	0.500	0.54	0.45
1898	0.788	0.44	0.60	1879	0.504	0.53	0.45
1897	0.708	0.40	0.40	1878	0.648	0.56	0.55
1896	0.712	0.47	0.55	1877	0.592	0.53	0.35
1895	0.652	0.40	0.35	1876	0.592	0.54	0.55
1894	0.708	0.47	0.55	1875	0.724	0.67	0.45
1893	0.684	0.46	0.35	1874	0.788	0.60	0.75
1892	0.656	0.51	0.50	1873	0.620	0.49	0.55
1891	0.656	0.49	0.45	1872	0.732	0.61	0.65
				1871	0.772	0.54	0.80
1890	0.732	0.47	0.55				
1889	0.644	0.51	0.45	1870	0.860	0.60	0.60
1888	0.620	0.43	0.45	1869	0.768	0.57	0.75

TABLE 2.—*Averages of the yearly growth, etc.*—Continued.

Year.	Average growth.			Year.	Average growth.		
	X Group of 25.	Y Group of 7.	Z Group of 2.		X Group of 25.	Y Group of 7.	Z Group of 2.
	Mm.	*Mm.*	*Mm.*		*Mm.*	*Mm.*	*Mm.*
1868	0.916	0.59	0.60	1840	0.772	0.59	0.45
1867	0.776	0.64	0.85	1839	0.848	0.77	0.55
1866	0.808	0.67	0.65	1838	0.788	0.76	0.45
1865	0.660	0.63	0.65	1837	0.844	0.71	0.45
1864	0.696	0.63	0.50	1836	0.868	0.63	0.55
1863	0.712	0.59	0.60	1835	0.880	0.61	0.45
1862	0.768	0.70	0.55	1834	0.888	0.67	0.60
1861	0.748	0.64	0.60	1833	0.920	0.63	0.55
				1832	0.908	0.59	0.50
1860	0.868	0.66	0.65	1831	0.804	0.56	0.40
1859	0.736	0.51	0.65				
1858	0.844	0.59	0.60	1830	0.864	0.44	0.40
1857	0.796	0.54	0.60	1829	0.664	0.56	0.25
1856	0.884	0.59	0.65	1828	0.824	0.53	0.45
1855	0.892	0.61	0.65	1827	0.724	0.47	0.35
1854	0.972	0.56	0.75	1826	0.760	0.46	0.55
1853	0.864	0.47	0.65	1825	0.684	0.67	0.55
1852	0.852	0.60	0.45	1824	0.680	0.61	0.45
1851	0.688	0.59	0.50	1823	0.672	0.61	0.40
				1822	0.632	0.63	0.45
1850	0.728	0.56	0.40	1821	0.608	0.53	0.50
1849	0.760	0.54	0.55				
1848	0.728	0.51	0.55	1820	0.600	0.51	0.50
1847	0.600	0.63	0.60	1819	0.716	0.77	0.40
1846	0.624	0.49	0.45	1818	0.772	0.69	0.55
1845	0.720	0.57	0.35	1817	0.640	0.54	0.40
1844	0.724	0.67	0.55	1816	0.872	0.73	0.45
1843	0.728	0.66	0.55	1815	0.940	0.79	0.45
1842	0.692	0.71	0.40	1814	0.872	0.70	0.45
1841	0.612	0.49	0.35	1813	0.824	0.64	0.25

TABLE 2.—*Averages of the yearly growth, etc.*—Continued.

TABLE 2.—*Averages of the yearly growth, etc.*—Continued.

Year.	Average growth. X Group of 25.	Y Group of 7.	Z Group of 2.
	Mm.	*Mm.*	*Mm.*
1812	0.968	0.61	0.50
1811	0.932	0.66	0.50
1810	0.928	0.64	0.50
1809	0.892	0.70	0.55
1808	0.962	0.77	0.50
1807	0.748	0.56	0.50
1806	0.988	0.74	0.50
1805	0.920	0.79	0.55
1804	0.832	0.66	0.40
1803	0.884	0.70	0.70
1802	0.904	0.77	0.65
1801	0.828	0.66	0.70
1800	0.972	0.73	0.55
1799	1.044	0.64	0.55
1798	1.000	0.69	0.45
1797	0.984	0.80	0.40
1796	0.984	0.91	0.55
1795	1.028	0.74	0.65
1794	1.004	0.64	0.70
1793	0.924	0.77	0.45
1792	0.808	0.73	0.60
1791	0.844	0.77	0.45
1790	0.920	0.61	0.45
1789	0.792	0.70	0.45
1788	1.016	0.66	0.50
1787	0.932	0.74	0.45
1786	0.872	0.76	0.40
1785	0.940	0.60	0.55
1784	0.904	0.69	0.70
1783	0.796	0.67	0.70
1782	0.760	0.61	0.50
1781	0.772	0.59	0.40
1780	0.840	0.76	0.60
1779	0.860	0.71	0.55
1778	0.944	0.84	0.70
1777	0.992	0.84	0.70
1776	1.000	0.81	0.65
1775	1.084	0.97	0.70
1774	1.028	0.86	0.80
1773	1.056	0.91	0.80
1772	1.208	1.00	0.90
1771	1.080	0.76	0.80
1770	1.080	0.83	0.75
1769	1.132	0.90	0.85
1768	1.136	0.87	0.80
1767	1.264	0.91	0.75
1766	1.164	0.90	0.90
1765	1.368	0.87	0.95
1764	1.328	0.74	0.60
1763	1.300	0.91	0.70
1762	1.252	0.83	0.75
1761	1.280	0.84	0.70
1760	1.312	0.90	0.60
1759	1.196	0.83	0.65
1758	1.136	0.81	0.70
1757	1.100	0.76	0.45
1756	0.992	0.80	0.65
1755	1.008	0.73	0.75
1754	0.952	0.64	0.50
1753	1.108	0.73	0.55
1752	1.060	0.81	0.65
1751	1.304	0.70	0.45
1750	1.020	0.73	0.70
1749	1.248	0.97	0.75
1748	1.356	0.86	0.60
1747	1.372	0.86	0.85
1746	1.384	0.80	0.75
1745	1.360	0.70	0.80
1744	1.268	0.74	0.75
1743	1.436	0.96	0.85
1742	1.324	0.87	0.75
1741	1.312	0.99	0.75
1740	1.328	1.03	0.95
1739	1.348	0.99	0.75
1738	1.416	0.76	0.65
1737	1.236	0.93	0.55
1736	1.492	0.81	0.60
1735	1.424	1.09	1.35
1734	1.332	1.04	1.30
1733	1.312	0.91	0.85
1732	1.488	1.00	0.90
1731	1.308	0.84	0.75
1730	1.424	0.93	0.80
1729	1.336	1.00	0.75
1728	1.512	1.00	1.05
1727	1.456	1.19	1.25
1726	1.548	0.89	0.80
1725	1.760	1.03	1.10
1724	1.464	0.99	1.00
1723	1.660	1.06	0.85
1722	1.516	1.03	0.95
1721	1.432	0.96	0.80
1720	1.604	1.09	0.80
1719	1.456	1.13	1.00
1718	1.492	1.09	0.90
1717	1.348	0.96	0.75
1716	1.416	1.00	0.70
1715	1.612	1.04	1.15
1714	1.456	0.90	0.90
1713	1.444	0.97	0.85
1712	1.556	0.93	0.70
1711	1.520	0.94	0.65
1710	1.568	0.83	0.85
1709	1.436	0.86	0.75
1708	1.512	0.94	0.55
1707	1.588	0.81	0.95
1706	1.520	0.83	0.70
1705	1.516	0.97	1.15
1704	1.428	0.76	0.65
1703	1.416	0.73	0.80
1702	1.368	0.84	1.05
1701	1.472	0.91	0.85
1700		0.81	0.95
1699		0.84	0.90
1698		0.81	0.85
1697		0.97	0.90
1696		0.80	0.80
1695		1.10	0.90
1694		0.99	0.85
1693		0.84	0.90
1692		0.67	0.75
1691		0.90	0.90
1690		0.83	1.05
1689		0.81	0.80
1688		0.86	0.80
1687		0.76	0.75
1686		0.83	0.75
1685		0.70	0.85
1684		0.77	1.25
1683		0.87	1.15
1682		0.71	0.80
1681		0.77	0.65
1680		0.84	0.70
1679		0.70	0.60
1678		0.71	0.65
1677		0.87	0.95
1676		0.84	1.00
1675		0.77	0.75
1674		0.83	0.70
1673		0.83	1.10
1672		0.80	0.65
1671		0.94	0.60
1670		0.80	0.70
1669		0.87	0.95
1668		0.97	0.60
1667		0.79	0.45
1666		0.84	0.65
1665		0.91	0.80
1664		0.77	0.85
1663		0.74	0.60
1662		0.91	0.80
1661		0.96	0.65
1660		0.93	0.70
1659		0.90	0.40
1658		0.89	0.40
1657		0.91	0.65
1656		0.79	0.55
1655		0.94	0.65
1654		1.06	0.75
1653		0.87	0.60
1652		0.84	0.50
1651		0.93	0.60
1650		0.86	0.55
1649		0.67	0.40
1648		0.84	0.50
1647		0.71	0.40
1646		0.77	0.70
1645		0.79	0.75
1644		0.77	0.65
1643		0.80	0.50
1642		0.89	0.75
1641		0.91	0.75
1640		0.84	0.65
1639		0.79	0.90
1638		0.94	0.65
1637		1.34	1.10
1636		1.21	0.75
1635		1.11	0.60
1634		1.24	0.85
1633		1.14	1.05
1632		1.29	1.25
1631		1.23	1.20
1630		1.47	1.40
1629		1.11	1.05
1628		1.03	0.70
1627		1.26	1.00
1626		1.24	1.10
1625		1.06	0.50
1624		1.03	0.85
1623		1.17	1.05
1622		1.07	1.15
1621		1.06	1.30
1620		1.37	1.15
1619		1.30	1.05
1618		1.31	1.20
1617		1.09	0.80
1616		1.46	1.05
1615		1.24	1.05
1614		1.13	0.75
1613		1.11	0.70
1612		1.43	1.15
1611		1.23	1.20
1610		1.17	1.00
1609		1.17	1.00
1608		1.36	1.05
1607		1.39	1.10
1606		1.37	1.25
1605		1.37	1.05
1604		1.31	0.85
1603		1.11	0.85
1602		1.20	1.55
1601		1.30	1.10
1600		1.14	1.10
1599		1.24	0.90
1598		1.43	1.10
1597		1.37	0.95
1596		1.10	0.95
1595		1.01	0.80
1594		0.87	0.50
1593		0.97	0.80
1592		1.19	0.95
1591		1.10	0.80
1590		1.31	0.75
1589		1.26	0.35
1588		0.99	0.70
1587		1.11	0.70
1586		1.33	0.70
1585		1.34	1.05
1584		1.66	1.20
1583		1.43	0.60
1582		1.94	1.65
1581		1.49	0.80
1580		1.57	0.65
1579		1.19	0.60
1578		1.37	0.40
1577		1.66	0.80
1576		1.49	0.65
1575		1.54	0.60
1574		1.64	1.05
1573		1.53	0.90
1572		1.64	0.85
1571		1.47	1.05
1570		1.26	1.20
1569		1.66	1.20
1568		1.53	1.20
1567		1.57	1.30
1566		1.37	0.75
1565		1.44	0.90
1564		1.51	1.15
1563		1.60	0.45
1562		1.80	0.95
1561		1.36	0.60
1560		1.51	0.85
1559		1.79	1.10
1558		1.47	0.50
1557		1.40	0.50
1556		1.40	0.75
1555		1.30	0.90
1554		1.26	1.15
1553		1.27	0.85
1552		1.36	0.65
1551		1.17	0.60
1550			0.55
1549			0.95
1548			0.55
1547			0.70
1546			0.75
1545			0.80
1544			0.85
1543			0.70
1542			0.40
1541			0.70
1540			0.75
1539			0.65
1538			0.55
1537			0.50
1536			0.55
1535			0.80
1534			0.80
1533			0.85
1532			0.50
1531			1.05
1530			0.65
1529			0.85
1528			0.85
1527			0.90
1526			0.55
1525			0.80
1524			1.15
1523			0.80
1522			0.80
1521			1.25
1520			0.75
1519			0.65
1518			1.25
1517			1.10
1516			1.05
1515			0.70
1514			1.20
1513			0.90
1512			1.20
1511			1.45
1510			1.10
1509			1.30
1508			0.60
1507			0.85
1506			1.30
1505			0.70
1504			1.35
1503			1.30
1502			1.90
1501			1.10
1500			1.55
1499			1.25
1498			1.25
1497			1.30
1496			1.10
1495			0.90
1494			1.15
1493			0.80
1492			1.10
1491			0.75
1490			1.50
1489			0.85
1488			1.20
1487			1.20
1486			0.85
1485			0.75
1484			1.40
1483			1.55
1482			1.25
1481			0.75
1480			0.95
1479			1.45
1478			1.25
1477			0.80
1476			1.40
1475			1.45
1474			1.75
1473			1.55
1472			1.40
1471			1.05
1470			1.55
1469			1.30
1468			1.00
1467			0.95
1466			1.10
1465			0.90
1464			1.20
1463			1.05
1462			0.85
1461			1.20
1460			0.80
1459			1.20
1458			1.10
1457			0.85
1456			1.80
1455			0.95
1454			0.90
1453			1.15
1452			1.10
1451			1.25
1450			0.80
1449			0.60
1448			1.20
1447			1.20
1446			1.20

TABLE 2.—*Average of the yearly growth, etc.*—Continued.

Year.	Average growth.			Year.	Average grow h.		
	X Group of 25.	Y Group of 7.	Z Group of 2.		X Group of 25.	Y Group of 7.	Z Group of 2.
	Mm.	*Mm.*	*Mm.*		*Mm.*	*Mm.*	*Mm.*
1445			1.40	1429			1.60
1444			1.40	1428			1.55
1443			0.95	1427			1.40
1442			2.10	1426			2.45
1441			1.20	1425			2.80
				1424			1.80
1440			1.80	1423			2.55
1439			1.55	1422			3.00
1438			1.25	1421			2.40
1437			1.70				
1436			1.70	1420			2.05
1435			1.75	1419			2.00
1434			1.20	1418			1.90
1433			1.55	1417			2.60
1432			1.30	1416			2.00
1431			1.50	1415			3.25
				1414			1.85
1430			2.15	1413			1.90

SQUALLS AND THUNDERSTORMS.

By J. LOISEL, D. ès S. Dated, Observatory of Juvisy.
[Translated from La Nature, 1909, 37:105-8, by C. ABBE, jr.]

Half a century ago thunderstorms were believed to be essentially local phenomena not subject to any [general] law. It was not until it had been shown that the majority of these storms travelled in a definite direction that a distinction was made between thunderstorms accompanying barometric lows and local or heat thunderstorms. I shall here confine myself to the consideration of the former class only. This class has been the object of researches by a large number of meteorologists: Marié-Davy, Mohn and Hildebrandsson, Abercromby, Ley, Köppen, Ferrari, von Bezold, Prohaska, and others. Each has untangled a portion of the truth, but to the French meteorologist, E. Durand-Gréville,[1] belongs unquestionably the credit for having sharpened the previously somewhat vague and indistinctly connected ideas, and for having adequately correlated the authentically verified facts bearing on this subject. He showed that the "cyclonic" thunderstorms are but an accessory result of a body of extremely complex phenomena—an organism one may call it—*the squall* (*le grain*), which is subject to fixed laws and forms an integral part of certain lows. He further showed that these constitute a regular incident, subject to definite laws, in the general circulation of the atmosphere.

The thunderstorm is a *thundersquall* (*un grain orageux*).

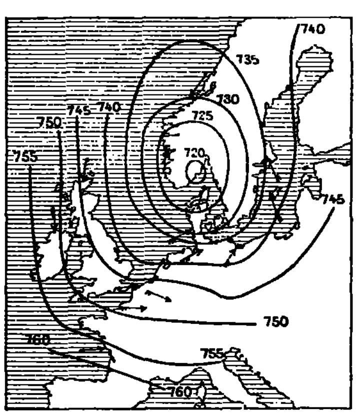

FIG. 1.—Pressure chart of western Europe, morning of March 12, 1906.

[1] E. Durand-Gréville: Les grains et les orages. Bur. cent. mét. de France, 1892; and Comptes rendus, 9 avril, 1894.

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Fig. 1 exhibits the barometric conditions prevailing over western Europe on the morning of March 12, 1906, with a barometric depression or low of regular outline central just south of Christiania. In certain lows, however, the isobars instead of curving so regularly present a zigzag at one or more points and Durand-Gréville has called this the "squall zigzag" (*zigzag de grain*). Figure 3 shows in a diagrammatic but accurate manner the details of this distortion of the isobars. The narrow band included between the dotted lines constitutes the "squall zone" (*le ruban de grain*). It starts in the vicinity of the center of the barometric depression or low and usually extends out to its boundary, thus having a length of 2,000 kilometers (1,243 miles), or even more at times, while its width varies from 10 to 80 or 100 kilometers (6 to 62 miles). The "squall zone," while remaining parallel to itself, moves across the country with its "low." If the depression moves eastward the "zone" follows it, perhaps gradually accentuating its convexity eastward as shown in the two maps of fig. 2. If the low retreats westward the zone retrogrades with it, as shown in fig. 4. If the low remains stationary, however, the "squall zone" does not necessarily follow suit; in the majority of cases it swings around the center of the depression.

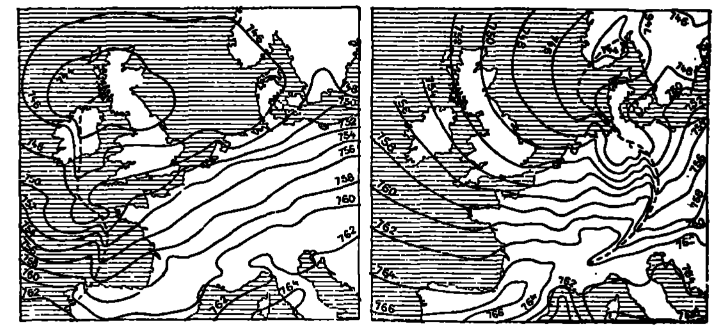

FIG. 2.—The eastward displacement of a "squall zone" (*le ruban de grain*).

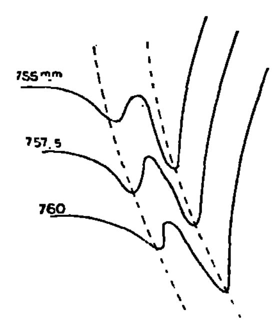

FIG. 3.—Course of the isobars within the "squall zone."

A general review of all the observed facts shows that the passage of a "squall zone" past each place is accompanied by the concomitant production of a certain number of phenomena which occur only within the limits of the zone. They begin at the moment when the "squall front" (*ligne de grain*) of the "squall zone" reaches the place of observation, they rapidly attain their maximum intensity, and then gradually weaken and die out as the rear of the zone passes and normal conditions become reestablished. But these accompanying phenomena may be more or less numerous, whence result many varieties of "squalls," each characterized by its appropriate phenomena.

We shall see that the phenomena observed during the passage of a squall are actually the results of two causes, one of these, the squall wind, is purely *dynamic*, pre-existant, and may be of distant origin, the other is the local condition of the atmosphere and is *static*.